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Thesis for the degree of M.D.

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Clinical Bacteriology.

In preparing this Thesis I have tried to bring together the conclusions arrived at by various authors as to the application of Bacteriology in Clinical Medicine & Surgery.

I have drawn largely from the *Précis de Bactériologie clinique* (Wulff), & from *Technique Microbiologique et Sérothérapique* (Besson).

In the majority of diseases dealt with the culture appearances of the micro-organisms concerned have been omitted.

As Appendices there have been added

1st Report of the Saprophy Commission in India

2nd An extract from Dr. Booker's interesting paper on Summer diarrhoea in Infants which is divided into four groups

A. group of 35 cases in which *Proteus vulgaris* appears of importance from a numerical standpoint

B. group of 27 cases in which micrococci appear of special importance

C. group of 6 cases in which are found the more insistent varieties of bacteria

D. group of 24 cases in which the *Bacillus Coli Communis* & the *Bacillus Lactis Aerogenes* are chiefly found.

3rd An appendix which contains notes made in Paris & a diphtheria chart in use at the Pasteur Institute. These were from notes lent me & information kindly given me by Dr. S. Newman.

BOOKS USED IN THE PREPARATION OF THIS THESIS.

TECHNIQUE MICROBIOLOGUE et SÉROTHÉRAPIQUE.

Besson, Paris.

PRÉCIS de BACTÉRIOLOGIE CLINIQUE.

Wurtz, Paris.

MANUAL of BACTERIOLOGY.

Muir & Ritchie.

MANUAL of BACTERIOLOGY.

Crookshank.

MICRO-ORGANISMS and DISEASE.

Klein.

PRACTICAL BACTERIOLOGY.

Ranthack & Drysdale.

PRINCIPLES and PRACTICE of MEDICINE.

Osler.

MALTA or MEDITERRANEAN FEVER.

Hughes.

INDIAN MEDICAL GAZETTE.

Pestis Asiatica.

Monograph. Bookers Paper.

BRITISH MEDICAL JOURNAL.

Saborana's researches.

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1a

In all Bacteriological examinations ^{we} should employ these methods:-

1. Microscopical examination.
2. Cultures on various media.
3. Inoculation of animals.

1. Microscopical examination of preparations, both stained and unstained will show morphological characters whether the organism is a bacillus or micrococcus, etc.

Hanging drop to show motility or not.

In staining use single and double stains and apply Gram's method.

2. Cultures.
 - a. Make plates and examine the colonies.
 - b. Stroke and stab culture, gelatine and Agar etc.
 - c. Anaerobic growth.
 - d. Sub-cultures.
3. Inoculate animals.

A Variety of methods ~~are in use~~

Methods of obtaining fluids, tissues, etc. for examination.

1. Hair.

Pull out the hairs and place them between two sterilised slides and wrap up in sterilised paper till ready for examination

2. Skin.

Shave the skin, wash it with soap and water, then with 1 in 1000 corrosive sublimate then in alcohol and lastly in ether, let the ether evaporate and lift up with a forceps a small piece of skin and cut it off. Place in sterile glass.

3. Sputum.

For Tubercle Bacillus it is sufficient to obtain sputum in proper vessel and examine as soon as possible. In special cases this method should be used:- The patient should rinse out mouth and back of throat several times with sterile water, and then expectorate into a sterile Petri dish. Wash the sputum well in sterile water to free it from extraneous organisms and inoculate various media with ^asmall part of the well-washed sputum.

One can obtain a more or less homogeneous fluid from sputum by the following method:- Add to the sputum an equal quantity of Liq. Potassae and heat. If the fluid is allowed now to stand in a conical glass or is centrifuged the sediment obtained can be examined for micro-organisms.

4. Blood.

Vide under blood infections, etc.

4. Urine.

Allow the urine to stand in a conical glass from 12 to 24 hours having first added a small quantity of Thymel, and examine the deposit. Or the deposit may be more easily obtained by means of the centrifuge.

After fixing the film, it is often well to clear up the specimen with warm water before staining.

6. Faeces.

Should only use a very minute quantity; the best way is to mix some of the faecis with sterilised water and pour plates in the usual manner and examine the colonies which appear. Should prevent the admixture of urine.

CLINICAL BACTERIOLOGY.

BLOOD INFECTIONS.

Methods of obtaining the blood for examination.

A. In the living.

1. Sterilise finger by washing with soap and water sublimate and alcohol, prick with sterilised lancet and make use of the blood which exudes.

2. Aspirate blood from vein in arm after sterilising arm and instrument, this gives larger quantity of blood which is very necessary in examination for micro organisms, since they are when present only in small number in the blood. Put the blood at once in a sterilised vessel.

3. By cupping, sterilise skin of back and apply a sterile cupping glass. When the cup has taken, scarify the cupped surface and reapply the glass; when sufficient blood has been obtained, remove the glass and cover it with a sterile top.

4. Puncture of various organs, lungs, liver, spleen.

B. After death.

1. From heart cavities, cauterise surface of heart and aspirate after puncturing through the cauterised part.

2. From the vessels, the method is the same as 1.

3. Other organs. Cauterise surface, incise with sterile knife and make use of the blood which exudes.

To make films.

1. Allow drop of the blood to spread between two glasses, slip them apart and dry in the air or on a copper lifter heated to 40°C - 45°C.

2. Place drop of blood on a slide and draw with platinum wire fine streaks along the slide.

3. Fold a piece of gutta percha tissue, pass the edge over the drop of blood and draw it carefully along the surface of the slide; this gives fine thin films (Manson).

Fixing the blood film.

The film should be well dried before fixing. Fixing the film by drying in the flame destroys the appearance of the red blood corpuscles. A variety of methods are described.

The film may be fixed by 1. Placing in hot air chamber for half an hour, or 2. In a saturated solution of corrosive sublimate for two minutes, then wash and dry. For various methods see Microtomists' vade-mecum by Bolles Lee page 457.

Stains.

Gentian Violet, Methylene Blue, Ziehl Neelsen stain the micro organisms but not the red blood corpuscles. The latter can be stained with watery solution of eosin. May stain the films first with a watery solution of eosin, then wash, and stain with Methylene Blue.

MICRO ORGANISMS in the BLOOD.

1. *Streptococcus pyogenes*. Only exists in the blood in rare cases in life, or entrance of the micro organism into the blood takes place just before death.

Von Noorden has found streptococcus in blood of a woman who died of erysipelas.

The organism which Klein separated from the blood in scarlet fever is identical with streptococcus (Crookshank.)

2. *Staphylococcus*. Has been found in the blood. May be present in cases of anthrax, osteomyelitis, etc. Primary cases have also been noted, one after boils where the patient did not live long.

3. *Pneumococcus*. Not constantly present in the blood of persons with pneumonia.

Talamon found this micro organism in case of pneumonia one hour before death. In the great majority of cases which die, the pneumococcus is found in blood clots in the heart after death.

Ettlinger and Berge state that the diplococcus is present in severe cases which terminate in death. In ten cases where the examination of the blood was negative, all recovered.

Jaccond has observed a fatal case where the micro-organism was present in the blood.

But in fatal cases there may be no blood infection.

Thus we may at present say that if the pneumococcus is present in the blood the case will probably end fatally, but the converse does not hold true.

Examine the blood on the 5th to 6th day in pneumonia by pricking the finger or blood from vein.

To stain. Stain in Carbol fuchsin 2-4 minutes, wash, deodorise rapidly with 1% acetic acid in distilled water.

4. Gonococcus. Hallier has found it in the blood of individuals suffering from gonorrhoeal rheumatism.

Trapesnikoff has never found it present.

Hewes found it once in four cases where there was general infection.

Thayer and Blumer found it in a case of ulcerative endocarditis consequent on gonorrhoea.

5. Eberth-Gaffky bacillus.

Negative result from the blood *as a rule*.

Positive from rose spots and spleen.

Probably some cases which have been reported as being typhoid bacillus in the blood have been Bacillus Coli Communis.

6. Bacillus Coli Communis.

Has been found in the blood in cases of cholera, dysentery, desquamative erythema, acute jaundice, urinary affections, peritonitis, etc.

7. Influenza. Probably there is an infection of the blood. Canon, Bruschettini and Pfuhl have isolated the bacillus from the blood, others have not been able to find it.

8. Tubercle. Bacillus found by numerous observers in the blood.

9. Anthrax. Only found in few cases and then generally in severe cases and just before death.

10. Glanders. Usually impossible to find the bacillus

in the blood. *Nocard* denies that it is present in the blood. The spread is mainly by the lymphatics and when the bacillus gets into the blood, it soon passes from the blood into the various organs.

11. Malaria. The protozoon of Lavarani is found in the blood. Each febrile attack is accompanied by the appearance of the parasites in the blood Vide Manson B.M.J. 1894 Vol III 1252 & 1307; Lancet 1895 Vol II 302, and Parasites of Malarial fever New Sydney Society 1894. Marchiafava and Bignani.

12. Recurrent fever or Relapsing fever.

Spirillum Obermeierii only exists in the blood at the onset of fever when they rapidly increase in number and disappear after the crisis.

13. *Bacillus Pyocyaneus*. Has been found by Calmette in the blood in cases of chronic dysentery.

PUS

In examination look to

1. Colour Green = Bacillus pyocyaneus
 Yellow - Staphylococcus pyogenes
 aureus
 Milky - Staphylococcus pyogenes
 albus.

2. The odour, if foetid, often means the presence of intestinal micro-organisms, bacillus coli communis or proteus or anaerobes. Note that the smell of coli cultivated as an anaerobe is very marked.

3. Consistence. Gives little information.

MICRO-ORGANISMS in PUS.

In making films only use small amount of material. After fixing it is often useful to clear up with acetic acid dilute.

Stains. Gentian Violet, Methylene Blue, or Dilute Carbol fuchsin. No pus occurs without micro-organisms or their products. May find Staphylococcus aureus: albus: citreus: cereus albus: cereus flav: — streptococcus pyogenes:-Micrococcus pyogenes ten:-Micrococcus tetragenus:-Pneumococcus-Bacillus of Friedlander, and Bacillus pyogenes foetid:-Bacillus typhosus: Bacillus Coli:-Bacillus pyocyaneus:-Gonococcus:-Tubercle Bacillus and Bacillus of Glanders and Leprosy, the latter from nodules in the skin:-Anthrax in the pus from carbuncle,-tetanus from wound discharge and various undetermined species, many of which are

anaerobes. One also finds actino^{myces} and madura disease.

1. *Staphylococcus aureus*. Almost constantly present in superficial suppurations of the skin, it exists normally on the skin and also in the air.

2. *Staphylococcus pyogenes albus*. Saphrophytic on skin and found frequently in superficial abscesses.

3. *Streptococcus pyogenes*. Met with in great number of general and local affections, may be alone or associated with other micro-organisms. In the suppurative complications of erysipelas it is constantly present, also in puerperal infections and in secondary infection after scarlet fever.

4. *Micrococcus tetragenus*. Found in pus from pulmonary cavities, purulent sputum of late phthisis and suppurations in head and neck.

5. *Pneumococcus*. Found in purulent collections in serous membranes in the viscera and in cellular tissue.

6. *Pneumo Bacillus*. In inflammatory conditions and normally in man. Sometimes found in pus.

7. *Bacillus Coli Communis*. Found in pus not only in abscesses connected with alimentary canal but also in other parts, e.g. in meningitis.

8. *Bacillus typhosus*. In pus chiefly found in periosteal tissues, the bacillus has its action superficially on the periosteum chiefly and is not found deeply. Long bones, especially the tibia, are affected. If the suppuration persists for a long time usually fail to find the bacilli which are outgrown by the ordinary pus organisms. Klemm states that the

infectious osteomyelites met with in typhoid are due to staphylococcus pyogenes, though the Bacillus typhosus may be a cause.

9. Glanders. The Bacillus *Mallei* occurs alone or with other micro-organisms.

10. Tubercle. Often difficult to find the bacillus in pus; inoculation will generally reveal its presence in such cases.

11. Gonococcus. Seen in the leucocytes which act as carriers of the micro-organisms, transporting it, it may be, to other parts.

12. Bacillus pyocyaneus. Considered by many as a mere saprophyte though at times it may have a pathogenic action.

13. Proteus vulgaris. Has been isolated from some purulent collections.

All the above micro-organisms may be found or mixed in pus and the non-pathogenic forms may increase the virulence of attenuated pathogenic varieties. May also find true anaerobes in the pus, e.g. tetanus. Lubinski has isolated two species of anaerobes; Veillon has isolated a strict anaerobe non-motile staining with Gram's method and producing in animals abscess with foetid odour. He has also obtained from pus from the middle ear two anaerobes, one staining with Gram the other not staining with Gram.

ALIMENTARY SYSTEM.

Mouth. Large number of micro-organisms are found in the mouth.

Micrococcus Roseus-Rosenberg

Sarcina Pulmonum (Hansen Phthisis)

" lutea

Staphylococcus pyogenes albus

" " aureus

Micrococcus tetragenus

Streptococcus pyogenes

Micrococcus of Manfredi

" gingivae pyogenes (Miller)

" candicans

salivarius septiens^{clus}

Diplococcus Pneumoniae

Bacillus mesentericus vulgatus

" termo of Vignal

" buccalis minutus

" dentalis viridans (Miller)

" Friedlander

" of Diphtheria

Tubercle Bacillus

Wurtz divides these ^{into} into two classes:-

1. Find these from passage of air into mouth
2. Usually in mouth.

Among those of most importance are:-

Fraenkel's Diplococcus: Streptococcus pyogenes:

Staphylococcus; Friedlander: Micrococcus tetragenus: Bacillus of Loeffler: Tubercle Bacillus and Actinomyces.

Saliva has a bactericidal action (Valude Sanarelli)

Stomatitis

If pus is present find various pyogenic organisms.

Salippe has described a small diplococcus and a bacillus as present.

The organism of aphthous stomatitis is unknown; the disease is probably transmitted to man from milk and water.

Siegel's organism is short and coccus-like and shows polar staining and is not stained by Gram.

No organism has yet been definitely described for noma. In thrush the oidium albicans is found in the form of branching filaments and spores. There is no liquifaction of the gelatine media, it forms white colonies on the nutrient media.

Gonococci have been found in the mouth in the cells.

Teeth.

Dental caries. A large number of micro-organisms, cocci, diplococci and bacilli have been described by Miller. When suppuration takes place staphylococci and streptococci are found.

Throat.

Ordinary sore throat. Veillon has isolated the following, streptococcus pyogenes, -pneumococcus, -staphylococcus. In scarlet fever find streptococcus, and the majority of observers agree that this organism is the cause of the condition found.

Syphilitic sore throat. Find streptococci, staphylococci, *Bacillus coli communis* and *oidium albicans*.

Diphtheria.

In the false membrane besides Loeffler's *Bacillus* a number of other micro-organisms are found. The bacilli are only found locally.

Microscopic examination.

1. Rub platinum loop over back of throat and make films.
2. Make film with piece of membrane removed from the throat.

The bacillus is seen in form of rods of various sizes: some about 2μ , others $3-4\mu$, others again $4-5\mu$ long. Martin says these long bacilli produce the most active toxin and that the toxin produced by the very short forms is almost inactive.

Bacillus is non motile, straight or slightly curved. Sometimes the ends are swollen or club shaped.

Stains

The *Bacillus* retains the stain in Gram's method.

Loeffler's blue is the best stain.

Note The irregularity in size and shape and irregular taking up of the stain by the bacillus, giving a somewhat beaded appearance.

To cultivate, may first with sterile cotton wool swab brush over back of throat and then inoculate 3 or 4 tubes of blood serum or 2nd Remove piece of false membrane, wash well in distilled water to get rid of surface micro-organisms and then rub it over the surface of the culture media. It is a good

plan to use several tubes to inoculate from the same swab or membrane, as though the first or second may give a mixed culture the third and fourth will probably give a pure culture of the micro-organism. Incubate the tubes at 37.5 and in within twenty four hours will find the typical circular discs with nucleated appearance. The pseudo diphtheria bacillus does not give results on inoculation like the true bacillus. In the membrane are present other organisms: Martin says that the presence of streptococcus pyogenes with the diphtheria bacillus implies a much more serious prognosis. There is little doubt that the more severe affections are accompanied by streptococci. It is to be noted that after recovery the bacillus persists for great length of time in the throat and nose.

The diphtheria bacillus is seldom ^{or never} found in pure state in the false membrane but usually associated with various micro-organisms.

Among these are:-

1. Coccus Brison. A small coccus staining with Gram, and on serum medium shows small white raised colonies. "The associations of this coccus with diphtheria are always benign."
2. Staphylococcus pyogenes. Respiratory complications are most frequent when this is present.
3. Streptococcus. Very grave. Broncho pneumonia is frequent.
4. Bacillus Coli Communis. Said to augment considerably the toxicity of the diphtheria bacillus (Blasi and Russo-Travalli.) Three cases in which these workers found this association died.

Diagnosis.

1. **Microscope.** Make films as above from the membrane and stain with Loeffler's Blue, wash and dry and mount.

Also stain by Gram's method. As many organisms found in the mouth do not retain the stain, this is a help in the diagnosis.

2. **Cultures.** On serum or blood agar at 37° C.

3. **Inoculation.** Make a culture in broth and at the end of thirty hours inject under the skin of a guinea pig 1 C C.

Besson classifies the results as follows:-

- a. If the bacillus is very virulent the animal dies in 24-30 hours
- b. If the bacillus is of average virulence the animal dies in 2-6 days.
- c. If the bacillus is little virulent the animal dies in 8-10 days.
- d. If only very slightly virulent, animal does not die, there is merely produced an oedema, followed by a scar.
- e. Lastly, if no lesion follows, the virulence is nil

Some practical points regarding the method in use for obtaining the antitoxic serum of diphtheria are given in the appendix. The method of preparing the toxine, estimating its strength, the immunisation of the horse, and the standardisation of the antitoxic serum need not be gone into here.

Retro Pharyngeal abscess.

The organism present is the streptococcus.

Infantile Cholera.

Booker, whose interesting report I have put in an appendix, says:- The proteus vulgaris is the commonest organism present in this complaint, and has pathogenic properties. Bacillus coli communis is present in great number.

Appendicitis. Some say the pathogenic agent is the Bacillus coli communis, but this is yet undetermined.

DIARRHOEA.

Klein has described-Local Government Board Report 1895-6-a micro-organism which he holds to be the cause of very acute diarrhoea, - the *Bacillus enteritidis sporogenes*. He says it is present in the human intestine, is a spore bearing bacillus, anaerobic, liquifying, producing marked odour in gelatine and milk. Causes of Diarrhoea-Investigations of Dr. Ballard Supplement to Report of Med. Officer to Local Government Board 1887.

1. Essential cause of diarrhoea resides ordinarily in superficial layers of the earth, where it is intimately associated with the like history of some micro-organism not yet detected or isolated.

2. The vital manifestation of such micro-organisms are dependent among other things perhaps principally upon conditions of season and on presence of dead organic matter which is its pabulum.

3. Such micro-organism is capable of getting abroad of its primary habitat the earth, and having become air borne obtains opportunity for fastening on non-living organic matter and of using such organic material both as nidus and as pabulum in undergoing various phases of its life history.

4. That from food, as also from the contained organic matter, particularly soils, such micro-organisms can manufacture by chemical changes wrought in them through certain of their life processes a substance which is a virulent chemical poison.

Diarrhoea is now believed not to result from the action

of pure culture, but by the association of many micro-organisms, e.g., *Bacillus coli communis*, pus, *sarcinae* and yeasts.

Vide also in Appendix Report of Dr. Booker on Diarrhoea in Children.

Tubercle of Intestine.

Bacilli have been found in the faeces, often probably from swallowed sputum; also in sections of the ulceration in the intestine. Hartmann and Lieftring have found the Tubercle bacillus in anal fistula of tuberculous patients. *Gonococcus* may be found in the rectum.

Peritonitis.

In the peritoneum normally no micro-organisms are present. In cases of peritonitis without perforation the *Bacillus coli communis* has been found in a state of purity in the peritoneum cavity, it penetrates the intestinal wall. Where perforation exists the *Bacillus coli communis* is present and has been proved by Larnelle to cause peritonitis in animals. In such cases this bacillus probably takes on a virulent nature, either by reason of the associated matter which escapes with it setting up irritation, or from associated micro-organisms.

Other Micro-organisms in peritonitis.

Streptococci in puerperal ^{infection} either alone or with staphylococci. A large number of cases of peritonitis in women are due to gonococci. Pneumococci are found in the peritoneum in cases of pneumonia; they are carried there by the blood. Some primary cases have been reported, they are generally mild. Toxines of bacilli are supposed by some to set up peritonitis.

Tubercular peritonitis.

Deboë and Renault state that ascitic fluid in tubercular peritonitis has a similar action to tuberculin. This being so, if the exudations appear sterile, for diagnosis it is only necessary, to try and obtain the tuberculin reaction in tuberculised animals.

Ascites. Hambruger from his experiments on calves concludes that this fluid contains the products of a bacillus.

Liver. During life the blood drawn off by puncture may be examined.

Bile. Normally is free from micro-organisms, but they rapidly invade the bile after death.

Gall stones. The *Bacillus coli communis* has been found present in the centre of recent gall stones. Does it set up the formation or does it merely enter into that formation? In dysenteric liver abscess the amoeba of dysentery have been found by many observers.

Suppurating hydatids. Organisms found *Staphylococcus pyogenes aureus* and *citreus* (More), *Streptococci* and *Diplococci* (Klemperer).

Weil's Disease.

In this disease which is characterised by fever and jaundice Fraenkel has isolated the *Bacillus coli communis*. Jaeger considered a bacillus which he has named the *Bacillus proteus fluorescens* as the cause.

Glanders in liver. Bacilli found in the cells

Anthrax in liver.

Bacilli in the cap~~s~~^{illaries}

Typhoid bacillus not constantly found in the liver.

SPLEEN.

Affected in most infectious diseases.

Enlargement of the spleen due to infection may be due

1. To bacilli
2. To toxins of bacilli
3. Parasitic (Malaria and Actino)

Due to bacilli - in typhoid frequent, -tubercular-pneumonia, -streptococci and staphylococci, -in relapsing fever Metchnikoff has found spirilla in the spleen, Anthrax bacilli often very numerous so as to form emboli.

CIRCULATORY SYSTEM.

Pericarditis

At post mortem to examine fluid in pericardium cauterise surface of exposed pericardium and draw off fluid by puncturing through the cauterised spot with a sterile needle. As a rule in a post mortem done soon after death get sterile effusion; if micro-organisms are present should try and find if the condition is a secondary one or immediately previous to death or ~~at~~ post mortem. -make films from the fluid and stain in ordinary way. Denuce in 2 cases of facial erysipelas has found the characteristic chains of streptococci in the effusion.

Secondary pericardites occur in rheumatism, ^{or} septic processes, e.g. puerperal fever.

3. Tubercle.

4. Eruptive fevers

5. Gout and other altered conditions of the system.

6. By extension of disease from other organs

Boulay has found pneumococci present. Tubercle bacillus may be present, to diagnose it is best to inoculate. In a case after whooping cough a micro-organism was found which set up in a rabbit paroxysmal cough. When the effusion becomes purulent the following organisms may be found ^{locus:} strepto^{locus:} staphyl^{locus:} pneumococcus and pneumo bacillus.

Endocarditis

Rheumatism is often associated with simple endocarditis, not so common with malignant endocarditis. May complicate pneumonia erysipelas, septicaemia, puerperal fever, and gonorrhoea. Rare with tubercle, typhoid and diphtheria. Various organisms have been

cultivated from the vegetations, among the most common being strepto: and staphyl: bacillus coli communis, pneumococcus, bacillus of tubercle, gonococcus, and anthrax bacillus.

The streptococcus pyogenes is frequent, especially in puerperal fever, the long chains of the micro-organisms are easily found; also in erysipelas when endocarditis is a complication. Staphylococcus pyogenes aureus found in the vegetations. Pneumococcus often in the course of pneumonia. Of all acute diseases complicated with severe endocarditis pneumonia heads the list. The pneumococci may be found in the blood of the heart and vessels, in the vegetations, but not on the surface of the valve vegetations. Tubercle rare, tubercle nodules on the valve have been found in a few cases. The typhoid bacillus has been found in very few instances. Gonococcus in endocarditis due to this micro-organism is not actually proved.

Endocarditis from eruptive fevers. In scarlet fever streptococci abound. Other micro-organisms which have been described:- The bacillus endocarditis Griseus of Weichselbaum, obtained from the ulcerated valves ^{is a} short motile rod, staining with gram. The micrococcus endocarditis-rugatus of Weichselbaum has also been found in the ulcerated valves. They are cocci which do not grow at ordinary temperature and which form small brown wrinkled colonies on agar.

Arteries. Examination of the aorta has chiefly been done, and revealed coexisting affections with those of the valves as above stated.

Phlebitis Puerperal due to streptococci Vidal has frequently found the streptococci in the coats of the thrombosed veins,

sometimes the bacillus coli communis is present.

In haemorrhoids, when inflamed, the bacillus coli communis may be isolated from the clot.

RESPIRATORY SYSTEM.

The micro-organisms usually present depend more or less on the organisms in the air unless we ^{could} keep the persons examined in sterile air for some days. Probably many of these micro-organisms get fixed in the mucus in the air passages and there die. Among the micro-organisms which have been found in various affections of the respiratory apparatus are Pneumococcus; Pneumo Bacillus; Diptheria, ~~Bacillus~~, Pyogenic cocci, Typhoid, ^{Bacillus}, Bacillus Coli Communis; and Influenza Bacillus. Many non-pathogenic microbes are also found.

Bronchi.

Normally the alveoli of the lungs contain no micro-organisms but in the bronchial tubes many may be present.

Bronchitis.

Examine the sputum. May find in it bacillus of influenza, of whooping cough, ^{*}Pseudo-diptheria, Bacillus, Pneumococcus; and tubercle bacillus. * undetermined.

Foetid Bronchitis.

Staphylococci, diplococci, and a Bacillus like the Bacillus of Miller have been isolated. Lumnitzer says this Bacillus is the cause of foetid bronchitis. It produces when injected into the lungs of rabbits an irritation which goes on to gangrene.

Pneumonia.

Netter says Pneumococcus present in bucal secretion of 20% of healthy persons. It persists for months in the saliva of persons who have recovered from Pneumonia.

In post mortem examination examine as soon as possible after death, cut through cauterised surface of lung, squeeze out a few drops of fluid and inject a guinea pig;—in the sputum stain with dilute Ziehlneelsen. Almost always one can find Fraenkel's diplococcus in the sputum, the capsule may contain from 2 to 6 elements; to stain place for two minutes in Ziehl-neelsen, wash in water & decolorise with acetic acid one drop to a tumbler of water. Note that the ends of the cocci should be lancet shaped and should occur in quantity as usually there are a few to be found in the saliva of healthy people. In cultures find no capsule present. The presence of the cocci in number in the sputum may enable one to diagnose pneumonia. This sputum is pathogenic for animals. Netter says that after the crisis the sputum is non-pathogenic.

Complications of pneumonia.

1. With presence of pneumococcus, the pleurae, pericardium, meninges, middle ear, peritoneum, kidneys, parotid, may be affected secondarily.
2. From other associated organs, e.g. streptococcus. When pneumonia complicates other diseases as a rule we find the pneumococcus present.

Broncho Pneumonia.

Most common organisms are Pneumococcus, streptococcus, staphylococcus, and Friedlander. The Klebs Loeffler bacillus may be found in secondary lesions of diphtheria. Mixed infections are the rule in broncho pneumonia. In measles and small-pox may find all above micro-organisms present. The clinical symptoms can hardly differentiate the chief pathogenic agent in

these bronch~~ial~~ pneumonias, but in streptococcic infection one finds marked dyspnoea oscillating temperature and epidemic character present.

Phthisis.

Examination.

Blood from haemoptysis if taken early yields a negative result as a rule, but if the clots which are expectorated two or three days after the haemorrhage are examined, the ~~Bacilli~~ will be found present in them.

Sputum in phthisis.

In acute millary tubercle often fail to find the Bacilli. In Caseous pneumonia find them in 50 per cent. In chronic ulcerated phthisis they are easily found.

Is a slender bacillus 2 - 5 μ long, often slightly curved, non motile. In the sputum and tissues ^{the Bacilli} are usually isolated, and more or less parallel to one another, or two bacilli forming an angle.

Stain.

Ziehl Neelsen method.

Diagnostic and Prognostic points regarding the presence of tubercle in the sputum.

Presence in the sputum = tubercle. Little closely packed masses of bacilli in the sputum are thought by some to indicate a cavity. The number of bacilli present is of no use for prognosis. May find many other organisms in the sputum; streptococci, staphylococci, micro-cocci, tetragenus, and sarcinae. Some say that the hectic fever is due in great measure to the accompanying organisms. Petruschsky thinks that

the streptococcus plays a main part in causing hectic fever.

Pleurisy.

~~Normally~~^{2nd} there are no micro-organisms in the pleural cavity. The pleurisy may be ~~eye~~^{er} Sero fibrinous, ~~the~~^{2nd} haemorrhagic, ~~the~~^{3rd} Purulent.

1. Sero fibrinous. Examination ^{of} film preparations ^{often} gives no result nor do cultures, inoculation is sometimes effectual if very large quantities of the fluid are used. The injection of the fluid into tubercular animals may give rise to a reaction like that of tuberculin. Often the sero-fibrinous effusions consecutive to pneumonia are sterile. The liquid may contain micro-organisms, and it is said that pleuritic effusions due to or accompanied by the pneumococ. in pure condition are benign. Those where streptococcus are present being much more serious.

2. Haemorrhagic. Are tuberculous, cancerous or due to haemorrhage into the pleura. Injection of the typhoid bacillus or of the Bacillus Coli Communis will set up this form.

3. Purulent. Netter in his Traite de Medecin distinguishes three classes, first due to pyogenic micro-organisms, secondly, tubercular, and thirdly putrid.

In the first are found streptococci and pneumococci, Streptococci, chiefly in the adult, pneumococci chiefly in children. Wurtz and Mosny state that in cultures of pneumococcus in broth there is a production of acid which kills the pneumococcus, but if we continue to neutralise the acid as it is formed, the pneumococcus will continue to live. In the lung it loses its virulence in a short space of time, but in the

pleura it lives long and keeps its virulence. The possibility being that in the one case (the lung) there is a production of this acid, in the other case (pleura) there may be a non-production or a neutralisation of acid production.

Secondly, Tubercular. In some cases may find nothing, inoculation will prove the diagnosis of tubercle. In a second class may find staphylococci only present, these also on inoculation may be proved to be tubercular. In a third and rare class, bacilli will be found. The bearing of the presence of organisms in the fluid on the prognosis has been stated thus - due to pneumococcus, they are mild, due to staphylococcus, slow to recover, due to streptococcus, serious. A sterile exudate suggests tubercle. When pneumococci^{are} present, the course is favourable. Streptococci are present in secondary processes.

KIDNEYS.

Pneumococcus has been found in the kidneys of patients suffering from pneumonia. Wright and Semple ^{7 Delapine} have described the presence of the typhoid bacillus in the urine and others have described it in kidney section. Manaberg says the chain-forming coccus described by him is the cause of acute nephritis.

CYSTITIS.

Three chief organisms are bacillus coli communis, pneumococcus and gonococcus.

URETHRA.

Coli has been found in the healthy urethra. Ordinary non-pathogenic micro-organisms are often present.

Gonorrhoea.

Should disinfect meatus and squeeze out a drop of pus. Is due to the gonococcus of meatus. Is in a pure culture at first, later on pyogenic~~at~~ organisms are also present. Complications are due to the gonococcus.

Chronic Urethritis.

It is important to find out if the gonococcus is present. If the examination is negative, may inject some solution of nitrate of silver, and so set up some irritation; the discharge that then comes away will, if the gonococcus is a cause of the Urethritis, contain the micro-organisms.

Orchitis.

Tubercular. The accompanying hydrocele contains the bacillus, but may not be able to find them; may diagnose by the ~~reaction~~ action. The bacilli have been described in the seminal fluid.

FEMALE GENITAL ORGANS.

Vagina.

Aseptic at birth. Vaginal Mucus is said to have a bactericidal action. Various bacilli and cocci may be present in the Vagina, as well as sarcinae and yeast fungi. During the periods, many micro-organisms are present, but in an attenuated state as regards virulence, possibly by the action of the vaginal secretion. Menge introduced into the vagina bacillus ~~pyocyaneus~~ *pyocyaneus* ~~staphylococcus~~ *pyogenes*, and streptococci. They soon disappeared, whether the reaction was acid or alkaline. Doederlein says that the normal acidity is due to the bacillus vaginae. The reason given for the disappearance of micro-organisms introduced into the vagina is, that a variety of factors caused their disappearance, viz., the antagonism of the bacillus of Doederlein, and the introduced micro-organisms, both directly and by the action of the products of the bacillus. This action is probably helped by the absence of free oxygen, by the acidity of the secretion, and by the chemical action of the vaginal mucus. During pregnancy the vaginal secretion is said to be strongly bactericidal. The uterus in its normal state, contains no micro-organisms, and the lochia do not normally contain them. One may here refer to the researches of Professor Bang of Copenhagen on Epizootic Abortion in cows. He isolated a small bacillus. The length of the bacilli is very variable, the largest are about as long as tubercular bacilli; the bacilli are non-motile. He cultivated the bacillus on serum gelatine, on which it appeared in the form of

small colonies just beneath the surface of the nutrient media. The bacilli retained their vitality for at least seven months, and it was found that injection of pure culture into the uterine cavity set up uterine catarrh, and was the pathogenic cause of this epizootic abortion.

In puerperal septicaemia, the constant organism present is the streptococcus.

NERVOUS SYSTEM.

In cerebro spinal meningitis, Weichselbaum found cocci in the cells which do not stain with Gram, and which he called the micro-cocci intracellularis meningitic. Pneumococci have been found in meningitis following pneumonia, in acute meningitis and in epidemic cerebro spinal meningitis. Howard quoted by Osler has found in a case of lepto meningitis infantum, a coccus and the bacillus coli communis. In brain abscess streptococci and Freidlander's bacillus have been isolated. The nature of the infection of many myel⁶~~ites~~ is still unknown although there is a probability that the morbid changes are due to micro-organisms or their products.

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Beri beri.

Pekelhering and Waring described a white coccus as the cause. This has now been proved to be the streptococcus albus. A diplococcus has also been described which on injection into rabbits gives rise to peripheral neuritis.

Zona.

The liquid is sterile. In a case under my care with three attacks in the last six months I have only obtained the staphylococcus in cultures.

Eye.

In Gonorrhoeal conjunctivitis Gonococci are present.

Ear.

In the pus of middle ear disease a large number of organisms have been found. Otitis due to pneumococcus is not uncommon in children with pneumonia, as a secondary condition. Streptococci and staphylococci are present in most Scarlatinal otitis.

Nose.

Ozena. Bacillus described by Loewenburg and Abel. Its microscopic and cultural character and the results of inoculation into animals are the same as those of the pneumo bacillus, but it does not ferment sugars nor coagulate milk.

Rhino scleroma.

The bacillus of Frisch. An encapsuled bacillus, like the pneumo bacillus, does not develop on slightly acid media, does not ferment sugar, capsule is present in cultured media, it does not coagulate milk.

Lymph glands.

Various micro-organisms infecting the system are arrested in the lymph glands as in anthrax where the glands corresponding to the point of inoculation are infected. Lodge has found the bacillus of anthrax in the bronchial glands of wool sorters' diseases. In erysipelas streptococci are present in the glands whose lymph vessels are in relation to the disease. The bacilli of tubercle and glanders are also found in the glands in the respective diseases. In scarlet fever the glands may be the seat of streptococcic infection.

SCARLATINA.

Bacillus is not known.

Klein isolated a streptococcus from the blood and tissues of persons with scarlet fever. This is now admitted to be the streptococcus pyogenes. Edington described a bacillus which is now found to be one of the ordinary bacillus of the skin. Crookshank says that the nature of scarlet fever is unknown; that the streptococcus of Klein is the streptococcus pyogenes; that this streptococcus is found sometimes in company with staphylococcus pyogenes aureus as a secondary result in scarlet fever and many other diseases, and its identity with the streptococcus of pus and puerperal fever were established by Fraenkel and Freudeburg in 1885.

Variola

Unknown. Cohn and Weigert found cocci in variolous lymph, Hlava found streptococcus pyogenes in the pustules, Garre found streptococcus in internal organs, Klein and Copeman found a small bacillus which they regard as characteristic occurring in calf lymph and human variolous lymph. — In calf lymph 72-92 hours after vaccination, in human variola during the third to the fourth day, the clear lymph was taken films were made treated with 30% acetic acid, stained with Gentian Violet. Klein concludes these are the bacilli of vaccinia.

In vaccine lymph it is known that filtered vaccine loses its properties. Buist separated three different species of cocci which on ordinary media gave rise to a white yellow and

orange colour.

Measles.

Organisms not known. Micro cocci have been found in the blood, catarrhal exudations, and the skin, Cannon and Pielicke found small bacilli in the blood in 1892. Czajowski states he has found a bacillus in the blood of 56 cases of Measles. Dohle describes flagellated organisms in the blood.

Whooping cough.

Burger obtained from the sputum a straight rod slightly constricted in the middle. Affanassiew describes short rods sometimes in twos and sometimes in chains which are motile and form round or oval colonies on media brownish in colour finely granular, non liquifying aerobic and staining with the ordinary stain. On injection into the larynx of animals the culture of this organism sets up a paroxysmal cough. This has been confirmed by Wendt but others have not done so. Ritter describes a diplococcus, very small aerobic growing at 30-40 C., found in masses or chains in the sputum. Injection into the trachea of dogs gave rise to cough; Cohn and Neumann found little cocci often in diplococcus form, but they do not think that these are the specific micro organism of whooping cough any more than are the above.

Yellow fever.

Delardo and Findlay have isolated a tetracoccus, the tetracmotilis. This may be isolated they say from the blood or the stools. Domingo Freire has described a small coccus which secreted a yellow and black pigment in gelatine cultures. Steinberg denies this; Cornil and Babes have found bacilli

in the intestinal contents.

Malta Fever or Mediterranean Fever.

A specific disease due to the micro coccus Meliten~~sis~~

Micro organism was found by Bruce in 1886 present in greatest numbers in the spleen. It grows best in media, the alkalinity of which is less than that of human blood, and its best temperature is 37-39 degrees, C. May inoculate broth or agar with blood from the spleen removed post mortem. In a hanging drop one sees minute cocci with rapid molecular movement, sometimes they are in pairs, sometimes in short chains. They stain readily and easily lose the stain. Stain them with gentian violet or methyl: violet.

At post mortem the organism is found in almost pure culture in spleen, liver and kidneys.

It does not pass into the blood.

During life may obtain the organism by puncture of the spleen.

STAPHYLOCOCCUS PYOGENES

Varieties:- Aureus, albus, citreus, etc.

These only differ by the colour of the cultures, their properties are the same, Besson agrees with Rodet and Coermont that they are all one species.

Habitat Air, water, skin, mucus membrane, alimentary canal, etc.

Pathologically are found in pus, boils, osteomyelitis, abscesses, pustule of ~~ecthyma~~. In certain cases passing into the blood may determine pyaemia. They are met with in pleurisy, suppurative peritonitis and ulcerative endocarditis. Present in skin diseases. They favour the development of the vib^{ion} septique. Garre has produced boils in man by rubbing the skin with culture of staphylococcus aureus.

Method of examination Microscopic. Prepare films of the pus or other fluids and stain some with ordinary stain, such as weak carbol fuchsine, others by gram, the staphylococcus is stained by gram, one sees spherical cocci in clusters. In culture, the staphylococcus pyogenes aureus (stab gelatine) ^{Novos} funnel shaped liquefaction ^{which} commences on second day, with deposit of bright yellow at bottom of the funnel. On agar stroke, a yellow faint appearance on surface in 24 to 48 hours. Milk is coagulated.

STREPTOCOCCUS PYOGENES.

Streptococcus pyogenes causes a great number of suppurations, puerperal fever, and phlebitis. It is the pathogenic agent of ^{certain} broncho-pneumonias, purulent pleurisies, peritonities,

meningitis, otitis, and is the micro-organism of erysipelas. Associated with other micro-organisms, it increases their virulence, as in influenza, diphtheria, and typhoid fever. It causes the complications of scarlet fever.

Examination. May examine films prepared from pus, blood, or effusions - stain with carbol fuchsin, or double stain with Gram's method. Occurs in the form of fine chains of various lengths. The Paris School now believe that all streptococci are members of the same family, all belong to same species, and differences found in their actions are only due to differences in their virulence.

ERYSIPELAS

Organism, the streptococcus.

To obtain pure cultures of the streptococcus, Achalme advises the following procedure:-

After carefully making the skin surface over the erysipelalous patch aseptic, apply a coating of collodion, when this is dry, puncture the skin through the collodion film with a sterilised needle, and draw up the first drops of blood in a pipette. Now squeeze the skin to make some serum exude from the swollen part, draw this fluid into a pipette, and examine (Wurtz)

The use of Marmorek's serum in streptococcic infection, whether in erysipelas, diphtheria, or scarlet fever, has not, so far, been more than encouraging.

GONOCOCCUS

Met with in the urethra, in vagina, and the different complications of gonorrhoea (~~salp~~^{sal}pingitis - ~~mit~~^{mit}tis) in cystitis, in gonorrhoid^{al} conjunctivitis.

Inoculation in man is found to set up the disease. Bumm - Bockart - Bokai.

Is a diplococcus, and in examination, bear in mind the following points.

1. Is bun shaped.
2. Does not grow in media which do not contain blood.
3. Is situated in the leucocytes.

4. Loses the stain in Gram's method-with regard to point 2, although direct culture from inoculation or discharges on gelatine or agar give negative result, for some time past it has been the custom at King's to sub-culture on gelatine and agar with positive results. The method adopted is to inoculate blood agar plates, incubate at 37.5 C., and when the typical colony has appeared, to make stroke cultures on agar and gelatine. Point 2 holds good, however, as Binot, of Paris, points out. He says there must be an organic liquid for the growth of the micro-organism, e.g. blister fluid, serum or blood or urine. Binot says when growth occurs as above described, it is due to absorption of organic matter into the micro-organism, and retention of sufficient of that organic matter to enable further growth to take place on ordinary media. But he says, if one continues to sub-culture on ordinary media, it will be found that after a short space of time, no growth takes place. He compares this to the introcellular poisons retention of Klein.

Stains with ordinary stains, does not stain by Gram's method.

To double stain, use the following method:-

Carbol gentian violet 4 - 6 seconds

Gram's solution ditto.

Decolorise with acetic alcohol.

Wash in water.

Place for a few seconds in the following solution,

Saturated alcoholic solution of fuchsine	5 c c
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Water distilled	100 c c
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Wash, dry and mount.

PNEUMOCOCCUS.

In Lobar Pneumonia, in normal saliva, in catarrhal Pneumonia, pleurisy, meningitis, nephritis, parotitis, suppurative arthritis, peritonitis, metritis,

And as a primary cause also in many cases, e.g. Pleurisy, pericarditis, otitis, peritonitis, meningitis.

May be found in,

1. The sputum.
2. In the pneumonic lung.
3. In pus and exudations.
4. In the blood.

Or post mortem in

1. The exude of incised lung.
2. Section.

Bouchard, Rager, Chairin, and Maragliano have obtained satisfactory results from the use of antipneumonic serum.

BACILLUS OF FRIEDLANDER.

Is the pathogenic agent of certain broncho pneumonias and of suppurations. Is notably found in suppurative Otitis, is met with in form of short rods, 1-2 M., sometimes filaments are seen non-motile; in pus sputum and blood it is found with a capsule.

To stain, use the ordinary basis dyes; does not stain with Gram. This bacillus is morphologically like the bacillus of Rhino and the bacillus of Ozaena, but it is distinguished by the difference on culture media and in milk, and by its fermentative action.

TYPHOID BACILLUS.

Met with in Typhoid Fever, in spleen - liver - mesenteric glands - peyers patches in the intestine, less frequently in the lungs and meninges, and does not pass into the blood.

In the rose spots Besson from 54 rose spots in 19 patients only in one obtained a culture of the bacillus.

The bacillus is met with in the urine, Besson concludes from his examination of the urine of 33 cases that the bacillus is to be met with chiefly when the urine contains albumen.

The bacillus is also found in a number of the complications of Typhoid.

Microscopically - Rods 2-4 in. long. 5 thick oval ends, very motile - Stains readily - with ordinary basic stains, does not stain with Gram.

Each bacillus has many (8-14) flagella, the method which has give me the best results in staining them has been Van Ermengem's. In culture, on potato see a glistening surface - milk is not coagulated.

Widals reaction. Serum Diagnosis of Typhoid.

Besson says a positive reaction is a certain sign of Typhoid, a negative reaction gives only a probability against the case being Typhoid.

Reaction appears from 5th to 7th day of disease.

One requires the blood and a culture with the bacillus in active movement.

To obtain the blood - after cleaning the finger of the patient obtain the blood from the pulp by puncture in the usual way, or by flexing the terminal phalanx may obtain the blood by incising the skin (this is the method advised by Delepine) close to the nail on the dorsal aspect. The blood can either be drawn up into a fine pipette or a capillary tube, which is then sealed. Or we may allow some drops of blood to dry on a cover glass or a piece of paper.

For the culture a broth culture of not more than 24 hours old is taken (or Agar sub-culture of 6-8 hours.)

Method. On a clean cover glass apply 9 drops separately of the broth culture (or of the condensation water of the Agar culture) with a small platinum loop now apply one drop of the clear serum which has separated from the blood and mix. Place on a slide and examine at once; the bacilli will be seen to be moving about but soon lose their motility and form clumps.

If the dried blood is to be examined it is only necessary to add to it a few drops of sterilised water and proceed as above.

If to a sterile broth tube some drops of serum from a Typhoid patient are added and the broth is inoculated with a culture of the bacillus a naked eye reaction will be seen after incubating at 37°C . from 18 to 20 hours. The bacilli form a mass at the bottom of the tube, the broth alone being clear.

This reaction is not a vital one of the bacilli, it is also seen in dead cultures. (Widal and Sicard) and (Wright

and Semple).

Clinically our bacteriological diagnosis of Typhoid rests on the reaction above described. Microscopic examination of blood from spleen may show bacilli, and cultures from the urine and faecis may be made.

Wright in the British Medical Journal 1897, describes the method he uses in obtaining a reaction from dead cultures of the Typhoid bacillus, and figures these special pipettes for use in this method.

BACILLUS COLI COMMUNIS.

Met with normally in the intestinal canal where it appears soon after birth and has usually little virulence. When it takes on a virulent nature it may cause Enteritis, Diarrhoea, infantine cholera, peritonitis (both with and without perforation and with strangulated hernia), Broncho-pneumonia - endocarditis - pericarditis, meningitis. Is the pathogenic agent of many urinary affections. In the female it plays a part in many pelvic diseases. It causes some of the complications in Typhoid. Is a small motile rod, with the same staining reactions as the Eberth Gaffky Bacillus, its flagella are not so long or numerous as the Typhoid bacillus, and the body of the organism is considerably smaller than that of the Typhoid bacillus in the preparations of flagella made by Ermengem's method. In fact if one examines preparations of the two bacilla from cultures on Agar of the same age 10-16 hours, stained with simple stain, the morphological appearance is very similar, but if Ermengem's method is used the difference between the two micro-organisms is at once apparent.

DIAGNOSIS OF THE BACILLUS COLI COMMUNIS AND THE BACILLUS OF TYPHOID FEVER.

	<u>B. C. C.</u>	<u>B. TYPHOID.</u>
1. Flagella.	Short only 4-8.	Long 8-20.
2. In Lactose) broth + calcium) carbonate at) 37°.	Abundant gas 12 to 36 hours.	No gas.
3. Culture in milk.	Coag. in 24 to) 36 hours)	No coagulation.
4. Stroke culture) on gelatine) lacto x with ad-) dition of <i>Vibrio</i> .)	Blue-red tint)	None.
5. Growth on potato.	Greasy yellowish.	Faint glistening.
6. Culture in Pep- ture-solution.	Indol.	None.
7. Widal.	No agglutination.	Agglutination. Besson.

Serum from Typhoid patients when used diluted $\frac{1}{5}$ to $\frac{1}{10}$ has an agglutinating action on the Coli Bacillus, this might induce error but the following method of working the reaction not only does away with error but is one of the best, if not the best differentiating character between the two micro-organisms:- thus,

1. Determine exactly the agglutinating power of the serum.
2. Act on the culture of bacillus coli. with the smallest dose of serum which distinctly agglutinates Eberth's bacillus e.g. agglutinating power may be in action on Typhoid bacillus in dilution of 1 in 100. This dilution should be used for

the bacillus coli.

In these conditions one never observes agglutination with bacillus coli. Sometimes the agglutinating power is very strong in the serum of Typhoid patients so that dilutions even of $\frac{1}{5000}$ or $\frac{1}{12000}$ produce the reaction.

Begin the reaction in Typhoid cases with dilution 1 in 10 then 1 in 20 then 1 in 30.

Widal and Sicard distinguish,

Agglutinating power very feeble. Inferior to 1 in 100.

" " feeble. From 1 in 100 to 1 in 200.

intense. " 1 in 500 to 1 in 2000.

very intense. Above 1 in 2000.

The Typhoid bacillus and the bacillus Coli. Communis are entirely different, the great distinguishing test at present laid stress on by the Paris School and especially there by Binot is that the Bacillus Coli. Communis in all its varieties does not agglutinate in the way the Typhoid bacillus does.

PLAGUE.

Bacillus found in abscesses and sometimes in the blood in severe cases. Wilm has found the Bacillus in the faecis and in the sputum of persons suffering from plague. Also found in the spleen, the glands, and rarely the blood. As found in the affected glands the bacilli are short rods with rounded ends, in cultures often show chain forms.

Stains.

Use ordinary stains - Does not retain the colour in Gram's method. The extremities are stained more deeply than the centre = polar staining.

Anti-plague serum.

Yersin has used the serum obtained from an immunised horse with favourable results.

PESTIS AMBULANS.

"The same micro-organism as above described has been found in mild cases described under the term Pestis Ambulans and there is no reason to suppose that if careful and patient research is made for this microbe in similar cases it will fail to be detected. The bacteriological examination of the blood will thus become as important a factor in the diagnosis of Pestis Ambulans as Bacteriological examination of the intestinal contents in cholera and the false membrane of the throat in Diphtheria. The fact that the diplobacterium can be found in the blood possesses a very practical bearing in the detection of mild forms of plague.

The occurrence of plague in India renders it important

to draw attention to a disease which may be designated as Pestis Ambulans.

Several writers have referred in their accounts of epidemics of plague to the occurrence of glandular enlargements, with or without pain, in persons who have remained well enough to follow their ordinary avocations and who get well without any treatment. These cases have always been a source of difficulty to the physician as to their real nature and the relationship which they bear to plague and to the important question of their isolation."

ACTINO-MYXOSIS.Microscope.

Break up one of the little yellow grains obtained from the pus, the sputum or the tissues and mount in a drop of glycerine. May stain with ordinary stain or with Gram's method.

May be found in pus, sputum faeces, urine, or in sections of tissues removed before or after death.

Find in preparations club-shaped bodies, filaments and spores.

STREPTOTHIX MADURAE.

Take the small yellow, gray or blackish grains obtained from the pus by incising one of the nodules and examine. Stain with Methylene blue or Carbol Fuchsin. Stain with Gram.

Hantack draws attention to the resemblance between this fungus & that found in Actinomyces.

ASPERGILLUS FUMIGATUS.

Frequently associated with Koch's bacillus.

Occurs in pigeon tenders.

Examine. Find the aspergillus in the sputum. Stains with ordinary stains and is + Gram.

Branching mycelia and spores.

CHOLERA.

Examination of the Stools.

Microscopic examination is not often conclusive. Though in some cases it may be sufficient. The organism is found most abundantly in the nucoïd masses in the stools.

Small comma shaped organism, film preparations in typical cases show the fish in stream appearance. Are motile, one flagellum^{only as a rule.} May stain with dilute carbol fuchsin. Or may use Gram's method and then stain with Carbol fuchsin dilute, the comma bacillus is stained red while other microorganisms which take Gram's stain are stained blue.

Comma bacillus loses the stain in Gram's method.

For diagnosis must depend on 1. Microscopic examination. 2. Culture appearances. 3. Growth in peptone solution. 4. Cholera red reaction. 5. Pfeiffers reaction. If the spirillum is repeatedly subcultured it assumes a coccal form.

Pfeiffers reaction. The injection of the spirilla into the peritoneal cavity of an immunised guinea pig is followed by loss of motility, breaking down and disappearance of the spirilla.

Brazançon says that the spirillum of Finkler and Prior is not the micro-organism of cholera nostras and that the spirillum of Deneke and the spirillum of Metchinkoff are neither pathogenic.

LEPROSY.

The Bacillus is found in tuberculous leprosy in the marrow of bones - in the spleen, in the glands. *In* The saliva if the buccal mucosa is invaded - the faeces where the disease occurs in the large intestine; and in the milk etc.

In the blood, Arning says the Bacillus is not met with, others say it appears in the blood shortly before death.

Method.

Make films from discharges or from scrapings, excised tissue, or sections and stain by Ziehl Neelsen method.

Besson gives the following points to differentiate this organism from the bacillus of Tubercle.

BACILLUS LEPROSY.

TUBERCLE BACILLUS.

Is stained by aqueous aniline colours.

Not coloured by aqueous solutions without mordants.

Colours with Gram's method.

Not coloured by simple Gram's method.

Take Ziehl and Ehrlich and resists long acid solutions.

Take Ziehl and Ehrlich but resists much less than the Bacillus of Leprosy decolourising Agents.

Stained by Baumgartens method.

Not so.

Bacilli in very great number in the interior of the cells of the Leprous nodules.

The Tubercle cells contain a limited number of bacilli.

Vide in the Appendix Report of Leprosy Commission and Report of post mortem appearances in a case of Leprosy.

GLANDERS.

Microscopic Examination.

In tissues and in pus met with in small masses.

Bacilli straight or slightly curved, best stain Loefflers Blue.

After staining bacilli show irregular staining giving them a granular appearance. The uncoloured parts are not spores.

Culture in Potato.

Characteristic, at first yellow, later chocolate colour.

Inoculation.

Surest method. Intraperitoneal injection into guinea pig and examine the tunica vaginalis for the bacilli.

When the bacilli appear in the blood the disease is rapidly fatal.

RECURRENT FEVER.

Spirillum of Obermeier. Can be obtained from the blood, but only appear during the attack, disappearing ~~with~~ intervals.

Film preparations are stained with one of the aniline dyes and counterstained with eosin.

TUBERCLE.

Small (2.5 - 3.5 long .3 thick) non motile rods straight or slightly curved. Often show irregular staining.

EXAMINATION.

1. In the sputum.

Use Ziehl Neelsen method.

2. In the blood.

Do.

3. In pus.

Do.

4. Effusions.

In the sero-fibrinous effusion of pleurisy, peritonitis pericarditis, etc. Microscopic examination is useless. The only reliable method is to obtain the reaction by inoculation of a tuberculised animal (method of Debove and Renault.)

5. Nasal Cavities.

Straus recommends well swabbing out the nostril 5 or 6 times with 5 or 6 different swabs of cotton wool and washing them carefully in some sterile water. This is then used to inject a guinea pig.

6. Urine.

Use the sediment, either obtained, from deposit in a large conical glass, or by means of the centrifuge.

7. Milk.

Inoculate guinea pig.

INFLUENZA.

PFEIFFERS BACILLUS.

Found in the sputum - nasal mucosa and in the respiratory passages.

Only exceptionally found in the blood.

The micro-organism which Canon and Bruschetti have found in the blood is not Pfeiffers bacillus but a small streptococcus. Klein has shown that there is a tendency to formation of false filaments i.e. a number of bacilli are seen lying end to end.

METHOD OF EXAMINATION.

Make films of a small piece of the characteristic bright yellow masses on the sputum and stain with dilute carbol fuchsin solution.

In sections from pneumonia lung in Influenza Pfeiffer recommends the following method:-

1. Half an hour in dilute carbol fuchsin.
2. Put into absolute alcohol (made faintly acid with acid acetic) for a few seconds.
3. Clear in clove oil and xylol and mount.

Very small bacillus, occurs singly or in chains, non-motile. Does not stain with Gram.

TETANUS.

Microscopic examination. Make films of pus or discharge from the wound if present.

Stain. Some with Carbol Fuchsin other by Gram's method.

The bacillus is a true anaerobe found in forms of rods 3-5 long, slightly motile-- forms spores and when does so the bacillus takes on appearance of a breast pin or drum-stick. In sections of excised cicatrix or ulcerated wounds in persons with tetanus find the bacilli present.

Confirm the diagnosis by culture under anaerobic condition.

If inoculate guinea pig, get tetanus in 24 hours contractions begin near the seat of inoculation. May be found in pure culture in the wound but more usually mixed with other micros, such as pyogenes organisms.

Boreil (Paris) in a paper ~~part~~ read ~~shortly~~ says that tetanus is a nerve poison entirely. He has been able to produce from the spinal cord what he says is the tetanus poison and has also prepared an antitoxin which cures tetanus in guinea pigs.

DYSENTERY.

Ogata. in an epidemic of dysentery in Japan examined the stools in 13 cases, and found small bacilli which were motile, present in great number. He obtained pure cultures and found the organism had pathogenic effects in animals.

Amoebic Dysentery, in tropical dysentery amoebae are usually present in the stools. They have slow movements, show an inner granular zone, are uncleated and contain vacuoles. They vary in form and shoot out pseudopodia.

Method of examination. Examine one of the small mucus masses found in stools, or harden a portion of the faecis in Müller's fluid and make sections, staining them with Methylene Blue.

Calmette says that of all the micro-organisms found in the stools the *Bacillus Pyocyaneus* is the most important and can reproduce the dysenteric lesions.

MALARIA.

To investigate the organisms in the blood, make as thin films as possible, and fix by, 1. Ehrlich's or 2. Gullands' method.

Stain with dilute eosin and wash, and then stain with Loeffler's solution, wash dry and mount.

ALOPECIA AREATA.

According to Sabouraud Alopecia and Seborrhoea are due to the same parasite.

He found that Alopecia areata started from a central point, and that the baldness spread from this point by creeping in every direction along its circumference, in the manner of a spot of oil in a fabric. His researches showed furthermore that the most pathologically active zone of the patch is situated at its confines, and that it is in this circumferential zone that the infected and broken hairs are found in the form of clubs.

A constant small bacillus was to be found infesting the upper part of the hair sac. He was further able to discover that the orifices of the follicles were filled with a fatty substance which could be squeezed out on pressure, and which he called the "seborrhoeic cocoon." In this seborrhoeic cocoon can be found, surrounded by a crowd of other microbes, the same organism which has been demonstrated in the histological section. It was necessary to discover a medium which should have the power of destroying all micro-organisms except the one in question. This consisted of a very acid culture medium, of which the ingredients are the following:-

Peptone	20 grammes.
Glycerine	20 "
Acetic acid.	5 drops.
Water	1,000 grammes.
Gelose	13 "

With this medium one obtains in many of the tubes, in the midst of other colonies, one or two pure cultures from the

beginning, which are visible on the 3rd to the 4th day, the temperature being 35° C. They show as pointed mounds, the color of which is a very characteristic brick-red on glycerine media. There still, however, remains a microbe which continues more persistently than any of the others; a white coccus. This organism must be got rid of by the use of immunised gelose. By using in the preparation of the gelose a liquid in which the white coccus has been cultivated a medium is obtained which gives from the first abundant and definitely isolated cultures of the bacillus already mentioned. Some rabbits were caused experimentally to lose their hair in bald patches.

The bacillus is stained by ordinary stains and also by Gram's method. Scrape the bald surface vigorously and put the scrapings on a glass. Wash in ether and then dry and stain or set up irritation by acid acetic to form a scale and remove scale, get rid of the grease, and stain.

He was struck by its resemblance to the microbe studied by Unna and described by Hodara as the bacillus of acne.

Sabouraud soon saw that Hodara's Bacillus is not that of acne, since it is found not only in the comedones, but in every form of oily seborrhoea, in the course of which the comedones of acne seem to be no more than an epiphenomenon resulting from local symbiosis; and that his bacillus of the seborrhoeic cocoon and Hodara's so-called acne-bacillus are certainly identical.

A preliminary study of seborrhoea in the hairy scalp revealed (1) that the bacillus of the brick-red cultures from alopecia areata is also present in the seborrhoeic plugs of the

mouths of the hair and sebaceous follicles in seborrhoea, that it is there present in considerable quantity, and that it certainly is the cause of seborrhoea; (2) that consequently seborrhoea and alopecia areata have a common origin from the same micro-organism. Sabouraud came to the conclusion that the disseminated loss of hair in seborrhoea was the prelude of baldness. When the specific bacillus of seborrhoea invades a follicle, it produces around it, and especially at its base, around the hair papilla, an afflux of wandering cells. The papilla gradually atrophies, producing as it does so a hair which is progressively more and more frail and devoid of pigment. Finally it dies, and the dead hair is expelled.

In hairy scalps which have been once invaded, the microbial infection remains endemic and settled so that a hair once shed is never renewed. Furthermore the permanent effusion of this germ bearing sebum infects one by one the follicles which have remained sterile. In this way ordinary baldness is little by little established; the whole part of the follicle invaded by the bacterial colony becomes hollow and broken up by narrow diaphragms which render the seat of infection inaccessible to external antiseptics. Sabouraud made a cultivation on a liquid medium, and having filtered it through porcelain, inoculated the filtrate deeply under the skin and into the muscular tissues of a rabbit. The rabbit at once commenced to shed its fur, and within 40 days from the date of inoculation, general alopecia was established.

We find (1) that the microbial origin of baldness is certain; (2) that the micro-organism of baldness is the same

as that of seborrhoea; (3) that it is identical with that of the seborrhoeic plugs of the orifices of the hair follicles in alopecia. areata.

LEPROSY IN INDIA

REPORT of the LEPROSY COMMISSION in India

1890-91.

The Bacillus Leprae is a rod-like parasite, the length of which is $\frac{1}{2}$ to $\frac{3}{4}$ the diameter of a human red blood disc; in breadth about one fifth of the length. It is straight, or slightly bent, with extremities that are pointed or slightly round.

In form and size Bacillus Leprae greatly resembles Bacillus Tuberculosis. A distinction is considered to exist between these in their behaviour to staining reagents, and this rests upon a micro-chemical reaction, dependent upon the behaviour of the investing membrane of the bacillus towards acids, alkalies and aniline dyes. The staining procedure employed as diagnostic of the Bacillus Leprae is as follows:- First treatment of the section of tissue, or film, fixed upon a cover glass, with warm Ziehl's solution for 12 minutes; second, decolorisation of the specimen in 25 p.c. nitric acid; third, washing in 60 p.c. alcohol; fourth, washing in distilled water. Cover glass specimens are at once examined in water, or after drying in Xylol-balsam sections are treated with absolute alcohol and removed to bergamot oil before mounting

in balsam. A saturated solution of Acetate of Potash is the best medium to mount specimens, as the colour disappears less rapidly. The Bacillus Tuberculosis is not stained by so short an immersion in Ziehl's solution, and all other bacilli that were stained would have been wholly decolorised by the acid, while the Bacilli Leprae resist this bleaching and stand out in the field of the microscope as bright red rods (Baumgarten). The grouping of the bacilli in clumps of cells of specific shape and structure is however characteristic of the Bacillus Leprae within the tissues of the body.

Fluids (Blood)

Köbner is the only pathologist who claims to have found leprosy bacilli in blood. All other observers have failed even during acute outbreaks of the disease, and it may fairly be doubted if the bacillus can live in the blood. Twenty-three cover glasses prepared from blood obtained from six lepers, failed in any case to shew leprosy bacilli. It is worthy of note that even where the blood was obtained by section of a tubercle, the results were negative. (Blister fluid) fifty-nine cover glasses were prepared and of these nine specimens from three different patients shewed Leprosy Bacilli in greater or less quantities. It must be noted that all these positive cases were in fluid obtained from blisters over actual tubercles. In blisters raised over anaesthetic patches or

normal skin no bacilli were in any case found. It may be safely affirmed that leprosy bacilli are always found in cutaneous and other tubercles at some period or other of their existence. The failure to find them is due either to error of preparation or observation, to the fact that no bacilli have happened to be expressed on the cover glass or to the fact that the tubercle is old and degenerating and the bacilli are consequently dead. That it is not always easy to obtain bacilli from leprosy tubercles is shewn by the observations recorded above that no bacilli were found in blood from tuberculated tissue. Evidently more than simple section of the tubercle is usually required to extract the bacilli. Compression must also be employed as recommended by Manson, or the blister method detailed above. In the discharge from tuberculated ulcers leprosy bacilli both free and in cells are more beautifully brought out by staining than perhaps in any fluid or tissue. Whether it is the bacilli in this discharge have been so macerated as to be divested of their mucin-like-hull is a question but the fact remains. In the discharge from anaesthetic ulcers, on the other hand, they could not be found. At Almara an experiment was made in which a leper washed his tuberculated and ulcerated feet in a basin of water. Examination of cover glass preparations from this water shewed leprosy bacilli in every specimen. Four cover-glass preparations from a leprosy ulnar nerve, operated upon by Surgeon Major Lawrie

at Hyderabad were examined, but no bacilli were found. Comparatively little value can however be attached to this observation, for bacilli in leprous nerves often escape notice unless sections are made. This of course was impracticable in the above case.

(Saliva) In many of the cases in which bacilli were found in the saliva the tongue was tuberculated, and in some cases ulcerated. It is not a matter of surprise that bacilli should be present in this secretion. Indeed, so frequently and rapidly do leprous tubercles of the tongue throat and larynx ulcerate, that the wonder is that bacilli are not more often found in the saliva.

(Vaginal Mucus) The first specimen was taken on the 24th June 1891 from a patient aged sixteen, suffering from mixed leprosy. Ten cover glass preparations were examined on 17th July 1891, and shewed an immense number of decolorised bacilli, with a few faintly stained ones. There were also staphylococci and beaded rods, sometimes stained pink. In one specimen were a few spore bearing bacilli, the spores being a deep red. There were no undoubted leprosy bacilli. The second specimen taken on the 24th June 1891 from a tuberculated leper aged eighteen. Ten cover glasses were examined on the 17th July 1891, and shewed numerous staphylococci, isolated bacteria and micrococci. In one specimen was a mass of six or seven

highly stained rods, which were possibly leprosy bacilli. Leprosy bacilli have been described in vaginal secretion by one or two observers (Kalin~~dero~~^{dero} and Ba~~les~~^{les}). The bearing of these observations on the question of inoculability of leprosy is obvious.

(Urine) The urine of six lepers was examined; two of them being mixed cases, three anaesthetic and one tuberculated. Four cover glasses from each case were taken, making twenty-four observations in all. In no case were leprosy bacilli found. This is not surprising, for very rarely are leprosy bacilli found in kidneys examined after death.

(Faeces) This excretion was examined in five lepers, two anaesthetic, two mixed and one tuberculated. Sixteen cover glass preparations were made, and in one from a mixed case bacilli were found. In this patient however, bacilli had been previously found in the saliva, so that it was impossible to keep them from the faeces.

Sputum from six lepers were examined, four cover glasses being taken from each case. Five of the cases were mixed and one tuberculated. All the patients had raucous voices, indicating leprous infiltration of the larynx. It is therefore to be expected that bacilli would be found in the sputum. It appears to us that it is absolutely impossible to confuse leprous and tubercular sputum. In the former case isolated

bacilli are very rarely seen, but large typical cells filled with bacilli to such an extent that it is difficult to recognize them individually, abound in advanced cases. In the absence of autopsies during the laboratory work, we are unable to speak definitely as to the existence of leprous phthisis. Leprosy bacilli were present in four out of the six patients, or in seventeen out of the twenty-eight specimens.

(Menstrual Discharge) This was sent by Dr Cook from Madras. The first specimen was from an anaesthetic leper aged forty. It was taken on June 28th and examined on July 17th 1891. Ten cover glasses shewed threads of epithelium bacteria micrococci, but no leprosy bacilli. These results are similar to those obtained from ~~V~~aginal mucus.

(Blister Fluid) Blisters were raised over tubercles on the ears, face and wrists at the same time, between normal skin on the shoulder blades. After avoiding all sources of fouling, sterilised vaccine capillary tubes were charged with a minute quantity of fluid from a blister over a tubercle and also with seven or eight times the quantity of fluid from a blister over the normal skin of the same leper. They were then sealed. Each tube also contained air for about one third its length. The dates of these experiments ranged from March 31st to May 13th. In all cases samples of the blisters, both over the tubercles and on the back, were examined for the bacillus.

CASE XXXVI. M.M.Aet.24.

Admitted 27th February 1893.

Left ulnar nerve - In the recent state enlarged and of tough consistence: transverse section measured 6 m.m. in diameter and was of pale pink colour.

Microscopic sections show epineurium, perineurium and endoneurium hyper-plastic, the tissue containing comparatively few nuclei. Collections of round, oval and irregular mononucleated cells occupy spaces between the thick vessels of fibrous tissue. A few strands of nerve fibres are seen here and there, mostly degenerated and consisting of primitive sheaths, containing broken-up myelin droplets. No typical nerve fibres were seen. The blood-vessels frequently have thickened walls, especially the external coat, and a few occluded vessels were met with. Some thin wall vessels occur in the cellular areas. Bacilli are numerous, but less so than in the nerves of Case XLVI. they are, moreover, less widely diffused. They are found in the cellular areas and also between the fibres, but are absent from the completely fibrosed parts: they occur for the most part in groups, rarely enclosed in cells, usually in a faintly granular or hyaline matrix. The groups are mostly rounded, but sometimes have an elongated form, as though lying in a canal. Single bacilli are comparatively few in number. The individual bacilli measure 2 to 4 in length, and about 3 broad straight ends rounded or tapering, sometimes pointed. Moniliform stainings. Fully formed bacilli are rare in the groups, which mostly contain

short rounded or irregular forms.

Femoral lymphatic gland. In the recent state the specimen examined was spherical in shape and soft. Transverse section red in colour and measured 15 m.m. in diameter. Microscopical sections show that the glandular structure has been fairly well maintained in spite of the great increase in size. Capsule and trabeculae show many spindle and round cell nuclei. Lymph sinuses of cortex filled with small and large mononucleated cells, lymphoid cells of nodules normal in appearance. The medulla shows some degree of fibrosis but the cells are normal. Many of the blood-vessels have thickened external coats and most of them are dilated: the gland is more vascular than normal.

Bacilli are extremely numerous and occur singly and in groups. They are found in the cortex, in the nodules and in the lymph sinuses, but were not met with in the medulla.

Spleen. In the recent state swollen, congested, soft, smear preparations were examined. In these were seen here and there fully formed bacilli and not enclosed in cells the bacilli presented no unusual characters.

Liver. In the recent state of normal size and consistence, section paler than normal. Microscopic sections, capsule normal, sub-capsular fibrous, tissue slightly increased. Portal canals, vein, arteries and bile ducts, normal in appearance. Excess of nucleated fibrous tissue and cellular elements. Liver cells somewhat granular but of normal shape; nuclei ill-defined, but stain fairly well. Between the liver cells there are numerous small round mononucleated cells. In some lobules this leucocytosis is most

marked in the portal zone and in others it extends throughout the entire lobule. Small rounded masses of retiform-like tissue containing normal cells are seen in many lobules, as a rule near the intralobular vein, but also elsewhere. The intralobular veins are normal in appearance. No bacilli were found.

Ovary. In the recent state small and of tough consistence, microscopic sections shew dense fibrosis of the stroma, Germinal epithelium has largely disappeared, no down growths were noticed. A few ill-formed Graafians follicles and ova were seen in the peripheral area, but no fully developed follicles. Several degenerated corpora lutea, more or less distorted in shape, are present as well as in some large empty cyst-like spaces. Blood-vessels are more numerous than normal. They frequently show thickening of the external coat and in the neighbourhood of the corpora lutea are dilated and congested.

Bacilli were present in comparatively small numbers in various parts of the stroma. They occur for the most part singly, either free in the inter-fibrous spaces or embedded in granular matrix. In certain areas large masses of yellowish granular material were found containing few fully formed bacilli, but many irregular and granular forms. Numerous small masses retaining a faint pink colour but showing no bacterial contents are also present. Individual bacilli measure 2 to 4 in length and about 3 broad. They are straight or slightly curved or twisted, ends tapering or rounded, sometimes swollen, rarely pointed, but the slightly irregular moniliform

4
staining is not specially evident but is seen in some.

Remarks.

The microscopical appearances indicate that the disease was widely diffused throughout the body and that the patient was suffering from advanced "mixed" leprosy. The detection of bacilli in the ovary is apparently rare, the only reports of their occurrence in this organ with which I am acquainted are those of Kalendero and Babes and of Arning.

The cause of the leucocytosis of the liver is not apparent. I was unable to find any signs of leprosy bacilli or other micro-organisms in the numerous sections examined.

The Morphological characters of *Bacillus Leprae*, as observed in the serum preparations made during the past year.

Smear preparations of serum expressed from tubercles dried in air and stained by the Ziehl-Neelsen or Cabbet methods, the bacilli were found free or within cells. The bacilli containing cells were usually larger than an ordinary lymphocyte and had a single or multipartite nucleus, commonly eccentrically placed. Occasionally two nuclei were present, but no multinucleated cells were observed in the specimens. The bacilli found free occurred singly or in groups.

Where two or three occurred together they were parallel or end to end, in the latter case they often formed an angle. No actual chains were observed. The groups were rounded, elongated or irregular in outline and the bacilli composing them usually crossed one another irregularly.

The majority of the bacilli were straight, some slightly curved or twisted. The ends were usually a little thinner than the rest of the bacillus (tapering) and as a rule rounded pointed ends were uncommon.

Swollen extremities were frequently met with and occasional swellings more in the middle of the bacillus. Swellings of one end only produced either a clubbed or drumstick form.

The bacilli usually showed alternately stained and unstained portions, the swollen ends, as well as the rounded and granular forms stained deeply.

The intracellular bacilli stained well, and presented the same characters as the free bacilli.

In the few specimens I have had an opportunity of examining unstained in the hanging drop I have not been able to convince myself as to the motility of the bacilli.

A Bacteriological and Anatomical Study of the Summer Diarrhoeas

of Infants.
By

WILLIAM D. BOOKER, M.D.

GROUP I.

Case Age	Duration of sickness diet.	Physical Condition.	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
I 3 months ¹	2 weeks. Milk.	Extremely emaciated, restless, tongue constantly twitching, pupils contracted, skin inelastic.	15 daily, dark green, fluid, putrid odor, alkaline reaction.	Leucocytes, enormous quantity of bacteria; oidium albicans abundant.	Bacillus coli com., bacillus lactis aerogenes and bacillus a numerous. Proteus vulgaris present in moderately large numbers
II 6 months	5 weeks Milk	Extremely emaciated, restless, skin inelastic.	Frequent, watery, offensive odor.		B. coli com. predominates, b. lactis aerogenes present in large numbers, proteus vulgaris in small numbers
III 6 months	... Milk	Extremely emaciated, drowsy, frequent vomiting.	Frequent, watery, offensive odor.		B. coli com., predominates proteus v. in large numbers, b. lactis aerogenes in small numbers.

¹ One month later the stools from this child were yellow, homogeneous and soft, and passed once daily. One week after the stools had been normal, cultures were again made from the contents of the rectum, from which only two varieties of bacteria were isolated, viz. bacillus coli communis and b. lactis aerogenes, the former greatly predominating.

Case Age	Duration of sickness, diet	Physical Condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
IV 4 months	10 weeks Milk	Extremely emaciated, restless, fretful, skin inelastic.	Not frequent, yellow and soft, putrid odor, alkaline reaction.	Almost exclusively bacteria; oidium albicans present but not abundant.	Gelatine tubes liquefied by proteus v. before other varieties could be estimated.
V 8 months	2 months Milk.	Extremely emaciated, restless, skin inelastic and cyanotic; abdomen sunken.	Frequent, thin, yellow, acid reaction.	Many leucocytes and bacteria	B. coli com. and b. lactis aerogenes in equal numbers and very numerous, proteus v. present in large numbers.
VI 7 months	2 weeks Milk.	Extremely emaciated, restless, skin inelastic and cyanotic; abdomen distended.	Frequent, watery, putrid odor.		B. coli com. predominates, b. lactis aerogenes and proteus v. numerous.
VII 5 months.	5 weeks Milk.	Extremely emaciated drowsy.	Not frequent, watery, yellow.	Few leucocytes, many bacteria; oidium albicans abundant.	Bacillus y predominates, b. lactis aerogenes present in large numbers, b. coli com and proteus v. in small numbers.
VIII 2½ months	2 weeks Milk.	Extremely emaciated, drowsy, skin inelastic, vomiting.	Frequent, watery, putrid odor, acid reaction.		B. coli com predominates, b. lactis aerogenes and proteus v. numerous.
IX 8 months	5 weeks Milk.	Extremely emaciated drowsy, vomiting.	Not frequent, greenish, fluid, putrid odor.	Many bacteria; oidium albicans present but not abundant; few leucocytes.	Proteus v. predominates b. coli com. b., lactis aerogenes numerous and equal in numbers.

Case Age	Duration of sickness diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
X 2 months	10 days Milk	Reduced in flesh, restless, vomiting.	Frequent, yellow, fluid, putrid odor.		B. coli com. predominates, proteus v. present in large numbers, b. lactis aerogenes present in small numbers.
XI 3 months	4 weeks Milk	Reduced in flesh, in state of collapse, vomiting.	Frequent, watery, putrid odor.		Proteus v. predominates, b. coli com. and b. lactis aerog- enes numerous.
XII 5 months	2 weeks Milk	Reduced in flesh, lively and playful, vomiting.	Frequent, yellow, fluid, putrid. odor, alkaline.	Chiefly bacteria.	B. coli com. predominates, ba- cillus a present in large numbers, proteus v. and bacillus lactis aerog. fairly numerous.
XIII 18 months	2 months Mixed	Reduced in flesh, playful.	Frequent, putrid odor.		B. coli com. predominates, b. lactis aerog. and bacillus z numerous; proteus v., bacillus a and bacillus d present in small numbers.
XIV 12 months	3 weeks Mixed.	Reduced in flesh, bright and lively.	Frequent, watery, putrid odor.		B. coli com. predominates; b. lactis aerog. present in large numbers, proteus v. in small numbers.
XV 12 months	10 days Nestle's food	Emaciated, stupor, pupils contracted and scum over eyes, pulse feeble, respi- ration irregular. Temp. 102.5° F.	Frequent, semi- fluid, brown col- or, putrid odor.	Red blood corpus- cles, epithelial cells, leucocytes, many bacteria, chain bacilli like bacillus z	Proteus v. predominates b. coli com., b. lactis aerog- enes and bacillus z numer- ous.

Case Age	Duration of sickness diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
XVI. 8 months	3 weeks Milk	Emaciated, skin pale, extremities cold, stupor, pupils contracted, pulse feeble. Temp. 99.2° F.	Frequent, whitish yellow, fluid.		B. coli com. predominates proteus v. present in large numbers.
XVII 4 months	4 days Milk	Emaciated, features sunken, in state of collapse. Temp. 101.7° F.	Frequent, grayish white fluid, sickly odor, alkaline.		B. coli com. predominates, proteus v., bacillus a and b. lactis aerogenes numerous.
XVIII 11 months	2 weeks Milk.	Reduced in flesh, stupor, vomiting, extremities cold, pulse 140. Temp. 97.8° F.	Frequent, watery, offensive odor, alkaline.		B. coli com. and proteus v. very numerous, b. lactis aerog. present in large numbers.
XIX 6 months.	5 weeks Milk		Not frequent, whitish yellow, soft, acid.	Large number of bacteria	B. coli com. predominates, proteus v. and b. lactis aerogenes numerous.
XX 8 months	5 days Milk	Reduced in flesh, stupor, vomiting	Frequent, whitish yellow, fluid, sickly odor, alkaline.	Chiefly forms like B. coli com., b. lactis aerogenes and a chain bacillus.	B. coli com. predominates, b. lactis aerog., proteus v. and bacillus a in small numbers.
XXI 7 months	5 days Milk	Reduced in flesh, pale, sickly appearance. Tem. 102.4° F.	Frequent, watery, offensive odor, acid.	Many forms like b. coli com. and chain bacilli.	B. coli com. predominates, proteus v. and b. lactis aerogenes numerous.
XXII 12 months	5 days Milk.	Emaciated, stupor, occasional loud cry, vomiting.	Frequent, yellow, fluid, offensive odor.	Chiefly bacilli, few cocci.	Proteus v., b. coli com., b. lactis aerogenes numerous.

Case Age	Duration of sickness diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
XXIII 3 months	8 days Milk	Pale, thin, very nervous, twitching at slightest noise Temp. 104° F.	Frequent, green, fluid, with white lumps and mucus.		Chiefly b. coli com., few of proteus vulgaris.
XXIV 11 months	8 days Milk	Reduced in flesh, skin inelastic, vomiting.	4 or 5 daily, whitish yellow, juicy and lumpy, acid odor.	Bacteria numerous, chiefly forms like b. coli com. and b. lactis aerogenes, few cocci.	B. coli com. predominates, proteus v. and b. lactis aerogenes numerous.
XXV 12 months	8 weeks Milk	Extremely emaciated, skin inelastic and cyanotic, bronchial breathing on left side, râles over whole chest, vomiting.	4 to 6 daily, yellow and green, semi-fluid.	Few epithelial cells and leucocytes, many bacilli, especially small slender bacilli, few cocci.	B. coli com., predominates, proteus vulgaris and bacillus lactis aerogenes numerous.
XXVI 12 months	8 weeks Milk	Twin of No. XXV and similar condition	Resembles No. XXV.	Small slender bacilli more numerous.	Similar to No. XXV.
XXVII 12 months.	8 weeks Milk	Restless and fretful. Temp. 101.5° F.	Frequent greenish, fluid, slimy, acid reaction.	Chiefly bacteria, many chain cocci and bacilli like bacillus <u>z</u> many leucocytes.	B. coli com. predominates, proteus vulgaris present in small numbers.
XXVIII 15 months	2 weeks Mixed	Fairly well nourished, in stupor, eyes half closed and congested. Temp. 99.2° F.	Frequent, yellow, low, fluid, putrid odor.	Leucocytes, oil globules, long and short bacilli.	B. coli com., b. lactis aerogenes, proteus vulgaris numerous.

Case Age	Duration of sickness diet.	Physical condition	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
XXIX 8 months	7 days Milk	Restlessness and sleeplessness, followed by collapse and drowsiness. Temp. 103.6° F. Weight 15 lbs 7 oz.	Not frequent, green or yellow fluid, putrid odor.	Few leucocytes great quantity of oil globules, many bacilli and streptococci.	B. coli com. predominates proteus v. and bacillus lactis aerogenes present in large numbers.
XXX 11 months	2 weeks Milk	Drowsy, reduced in flesh, weight 14 lbs 3 oz. Temp. 99.4° F. Vomiting.	Frequent, green and slimy, putrid odor.	Many leucocytes, oil globules, bacilli, and streptococci, many very small bacilli and cocci.	Proteus v. and bacillus coli com. very numerous, few small cocci.
XXXI 5 months	2 weeks Milk	Emaciated, skin grayish, drowsy, weight 8 lbs Temp. 102.6° F.	Not frequent, pasty or fluid, putrid odor, alkaline.	Many bacilli of different forms and sizes, many long narrow bacilli, few cocci.	B. coli com. predominates, proteus v., b. lactis aerogenes and streptococci present in small numbers.
XXXII 17 months	1 month Mixed	Reduced in flesh, weight 17 lbs 12 oz., drowsy. Temp. 101° F. Vomiting.	Frequent, green with white lumps and mucus, putrid.	Many red blood corpuscles, leucocytes, bacilli and streptococci.	B. coli com. predominates proteus v. and streptococci in large numbers.
XXXIII 6 months	few days Milk.	In state of collapse, reduced in flesh.	Frequent, greenish, fluid, putrid odor		B. coli com. predominates, proteus v. and b. lactis aerogenes numerous, many streptococci.
XXXIV 9 months	2 weeks Milk,	Well nourished, weight 16 lbs 12 oz., drowsy and perfectly relaxed, vomiting. Temp. 103.6° F. Child is greatly improved 2 days later	Not frequent, greenish yellow, soft, putrid odor.	Immense numbers of bacteria, chiefly forms like bacillus coli com., many streptococci and involution forms	B. coli com. predominates, proteus v., bacillus lactis aerogenes and streptococci in large numbers.

Case Age	Duration of sickness diet.	Physical condition	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
XXXV 10 months	Few days. Milk.	Reduced in flesh, in state of collapse.	Frequent, watery, putrid odor.	Few epithelial cells and leuco- cytes, immense number of ba- cilli, many long, narrow, light- staining bacilli, streptococci, few spirilla.	Colonies too thick for identification; <i>b. coli</i> com. and <i>proteus vulgaris</i> in large numbers.
GROUP II.					
XXXVI 5 months	8 days Milk	Fairly well nourished, weight 10 lbs 12 oz., fret- ful, vomiting.	Frequent, green- ish yellow, fluid, putrid odor, much mucus.	Many leucocytes, enormous quan- tity of strepto- cocci.	<i>B. coli</i> com. predominates, <i>b.</i> <i>lactis aerogenes</i> , <i>proteus v.</i> and streptococci present in large numbers.
XXXVII 6 months	5 days Milk	Greatly reduced in flesh, fretful, vomiting.	Frequent, green, fluid, offensive odor, alkaline.	Many bacilli like <i>b. coli</i> com., <i>b.</i> <i>lactis aerog.</i> and many strepto- cocci.	Apparently pure of bacillus <i>coli communis</i> .
XXXVIII 8 months.	2 weeks Milk	Emaciated, stupor, pupils contracted, respiration sigh- ing.	Frequent, brown- ish yellow, fluid, putrid odor, acid re- action	Bacteria numer- ous, small slend- er bacilli and cocci numerous.	<i>Proteus v.</i> , bacillus <i>a. b. coli</i> com. and streptococci nu- merous, <i>b. lactis aerogene</i> in small numbers.

Case Age	Duration of sickness, diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
XXXIX 7 months	8 days Milk	Emaciated, stupor, vomiting, has thrush.	Frequent, yellow, fluid, sickly odor, alkaline.	Large number of bacilli and cocci, many slender bacilli, few fungi and infusoriae	Chiefly b. coli com. and streptococci, b. lactis aerogenes in small numbers.
XL 3 months.	4 days Milk	Slightly reduced in flesh, stupor, pupils contracted, eyes glassy and congested, vomiting.	Frequent at first, not so frequent now, greenish, fluid.	Large number of bacteria, many streptococci and forms like aerogenes.	B. lactis aerogenes predominates, proteus v. and b. coli com. numerous, few streptococci.
XLII 3 months	... Milk	Greatly reduced in flesh, stupor, vomiting.	Frequent, yellow, fluid, acid reaction, not offensive.	Many round cells, many streptococci and slender bacilli.	B. coli com. predominates many streptococci.
XLIII 20 months	1 week Milk	Slightly reduced in flesh, restless. Temp. 106° F.	Frequent, thin, green, and slimy, offensive odor.	Immense number of bacilli and streptococci.	B. coli com. predominates, cocci and b. lactis aerogenes present in small numbers.
XLIII 3 months	2 weeks Milk.	Emaciated, skin cyanotic, ribs beaded, coarse râles over chest, vomiting. Temp. 103°.	Frequent, green and yellow, fluid, acid reaction.	Epithelial and round cells, many bacilli and cocci.	Chiefly bacillus coli com., streptococci and b. lactis aerogenes numerous.
XLIV 7 months	3 weeks Milk	Reduced in flesh, rectum protrudes at stool, vomiting, ribs beaded.	5 to 8 daily, green and slimy.	Many round cells, many bacilli and cocci.	Chiefly b. coli com., b. lactis aerogenes, bacillus a and cocci present in small numbers.

Case Age	Duration of sickness, diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
XLV 11 months	3 weeks Milk	Reduced in flesh, drowsy. Temp. 103°.	6 to 8 daily, whitish yellow, many fluid.	Many leucocytes, many bacilli and cocci.	B. coli com. predominates, many cocci.
XLVI 3 months	2 months Milk	Greatly reduced in flesh sallow skin.	3 to 5 daily, green and slimy.	Large number of leucocytes.	B. coli com. predominates, b. lactis aerogenes and cocci in large numbers.
XLVII 8 months	3 weeks. Milk.	Reduced in flesh, restless and fretful, vomiting.	Frequent, green and slimy, some blood.	Leucocytes, many cocci.	Chiefly b. coli com., many cocci.
XLVIII 4 months	2 months Milk	Greatly reduced in flesh.	4 to 8 daily, green and slimy, and frothy	Many leucocytes, many bacilli and cocci.	Nearly pure of b. coli com. and streptococci in equal numbers.
XLIX 6 months.	2 weeks. Milk.	Greatly reduced in flesh.	3 to 6 daily, white lumps in greenish pulpy substance.	Leucocytes, cocci predominate, many bacilli.	Cocci predominate, b. coli com. and b. lactis aerogenes in large numbers.
L 9 months	2 months Milk	Fairly well nourished, pale and fretful.	4 to 7 daily, green and slimy, acid odor.	Many leucocytes; few red blood corpuscles, many bacilli and cocci.	B. coli com. predominates, b. lactis aerogenes and strep- tococci present in large numbers.
LI 13 months	1 week Milk.	Fairly well nourished.	4 to 8 daily, green and pulpy.	Few leucocytes, many bacilli and cocci.	Proteus v. present in large numbers, liquefied tubes before differentiation.
LII 3 months.	2 weeks Milk.	Emaciated, frequent vomiting.	4 to 9 daily, green and slimy.	Many leucocytes, bacteria not so numerous, cocci predominate.	Streptococci predominate, b. aerogenes in larger numbers than b. coli com.

Case Age	Duration of sickness, diet.	Physical condition	Stools		Sultures from contents of rectum.
			Macroscopic	Microscopic	
LIII 9 months	2 weeks. Milk.	Reduced in flesh, drowsy, bronchial râles. Temp. 105° F.	3 to 11 daily, green and slimy.	Many leucocytes and epithelial cells, bacteria numerous.	B. coli com., b. lactis aerogenes and streptococci numerous.
LIV 13 months	3 weeks. Milk.	Fairly well nourished, bright and playful.	Frequent, slimy from beginning.	Many leucocytes, bacilli and cocci numerous	Proteus v., b. coli com. and streptococci numerous.
LV 9 months	4 weeks. Milk.	Emaciated, skin inelastic and sallow.	Frequent, yellow and slimy, acid odor.	Many leucocytes, bacilli and cocci numerous.	Streptococci predominate, b. coli com. present in large numbers.
LVI 10 months	5 weeks Milk	Reduced in flesh, drowsy.	4 to 8 daily, brown and lumpy, blood and mucus.	Leucocytes, red blood corpuscles, many bacilli and cocci.	Chiefly b. coli com. and b. lactis aerogenes, many streptococci.
LVII 6 months.	2 weeks Milk.	Reduced in flesh, drowsy, vomiting.	4 to 5 daily, green or yellow, thin, offensive.	Leucocytes, many bacilli and cocci, few sparsilla.	Chiefly b. coli com., many streptococci.
LVIII 9 months.	3 weeks Milk.	Greatly reduced in flesh, very restless.	Frequent, green and slimy.	Leucocytes, strep- tococci predomi- nate, some ba- cilli.	Chiefly b. coli com. and streptococci.
LIX 15 months	3 weeks. Milk.	Well nourished and playful.	4 to 8 daily, green and slimy, some blood.	Leucocytes, many bacilli and cocci.	Chiefly b. coli com. and streptococci.

Case Age	Duration of Sickness, diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
LX 15 months	3 weeks Mixed.	Well nourished, spleen enlarged and hard.	Not frequent, green, slimy and some blood.	Leucocytes, red blood corpuscles, many bacilli and cocci.	Chiefly <i>b. coli</i> com. and <i>b. lactis aerogenes</i> .
LXI 16 months.	1 week Milk	Fairly well nourished, vomiting after each feeding. Temp. 99°-100° F.	8 to 12 daily, green and slimy, some blood.	Leucocytes, many cocci and bacilli.	Chiefly <i>b. coli</i> communis.
LXII 9 months.	6 weeks. Milk.	Extremely emaciated, skin inelastic, râles over whole chest.	2 to 3 daily, yellow, lumpy and offensive.	Few leucocytes, many bacilli like <i>b. coli</i> com., few like aerogenes.	Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> in small numbers streptococci and liquefiers.
GROUP III.					
LXIII 4 months.	4 weeks Milk.	Extremely emaciated, skin inelastic.	20 to 30 daily, whitish yellow, soft, not offensive.	Few epithelial and small round cells, many bacteria.	<i>Bacillus x</i> predominates, <i>b. coli</i> communis in large numbers.
LXIV 8 months	4 weeks Milk	Extremely emaciated, skin inelastic and cyanotic, drowsy, vomiting.	Frequent, green, fluid, putrid odor, acid.		<i>B. coli</i> com. predominates, bacillus <i>a</i> present in large numbers, <i>b. lactis aerogenes</i> in small numbers.

Case Age	Duration of sickness, diet.	Physical condition	Stools		Cultures from contents of rectum
			Macroscopic	Microscopic	
LXV 16 months	4 weeks Mixed	Emaciated, fretful, skin inelastic and cyanotic.	Frequent, yellow and slimy putrid odor.	Chiefly bacteria	B. coli com. predominates, bacillus <u>y</u> and b. lactis aerogenes present in large numbers.
LXVI 5 months	2 weeks Milk	Reduced in flesh, playful and lively.	Frequent, yellow lumps in whitish yellow fluid, putrid odor, alkaline.	Few leucocytes many bacteria.	B. coli com. predominates, bacillus <u>a</u> , bacillus <u>d</u> and b. lactis aerogenes present in small numbers.
LXVII 9 months	7 weeks. Milk.	Emaciated, anaemic, skin inelastic, rales over whole chest.	2 to 3 daily, green and lumpy offensive odor.	Few leucocytes many slender bacilli, few cocci.	B. coli com. predominates, bacillus <u>a</u> and b. lactis aerogenes present in small numbers.
LXVIII 6 months.	2 months Milk.	Reduced in flesh, drowsy, vomiting.	Not frequent, green and lumpy, acid reaction.	Enormous quantity of bacteria, chain bacilli, most numerous.	B. coli com. predominates; b. lactis aerogenes present in large numbers.
GROUP IV.					
LXIX 5 months	... Milk.	Fairly well nourished, appears very sick. Temp. 102° F.	Not frequent, green, fluid, putrid odor.	Many bacilli like b. coli com., b. lactis aerogenes and long thin bacillus.	Chiefly b. coli com., b. lactis aerogenes and liquefiers present in small numbers.

Case Age	Duration of Sickness, diet.	Physical condition	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
LXX 10 months	8 days. Milk.	Slightly reduced in flesh, drowsy, vomiting. Temp. 101°.	Not frequent, green, fluid, putrid odor.	Large number of bacteria, chiefly like b.coli.	Nearly pure of b.coli com., few cocci.
LXXI 12 months	2 months Milk.	Emaciated, drowsy, skin inelastic, vomiting.	Frequent, yellow, fluid, putrid.		Chiefly b.coli com., b. lactis aerogenes present in small numbers.
LXXII 4 months.	4 weeks. Milk.	Pale and emaciated, vomit- ing.	Not frequent, watery, acid.	Chiefly bacteria.	Pure culture of b.coli com- munis.
LXXIII 12 months	2 weeks. Milk.	Reduced in flesh, playful, vomiting	Frequent, soft, yellow, acid odor.	Bacteria not very numerous.	B.coli com.predominates, b. lactis aerogenes present in large numbers.
LXXIV 9 months.	1 week. Milk.	Well nourished and playful.	Frequent, thin, yellow, putrid odor, acid reaction.		B.coli com.predominates, b. lactis aerogenes present in large numbers,
LXXV 7 months	1 week. Milk.	Well nourished, vomiting.	Frequent yellow, fluid, offensive, acid reaction,		Pure of b. coli communis.
LXXVI 12 months.	10 days. Milk.	Well nourished and playful, vomiting.	Frequent, yel- low, fluid, disagreeable fecal odor.		B.coli com.largely predomi- nates, b.lactis aerogenes and bacillus <u>a</u> present in small numbers.
LXXVII 5 weeks.	3 days Milk.	Fat and well nourished, vomiting	Yellow, soft, uniform, acid.	Chiefly bacteria.	Chiefly b.coli com., aerogene present in small numbers.

Case Age	Duration of sickness, diet	Physical condition	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
LXXVIII 3 months	2 weeks. Milk.	Well nourished.	Frequent, thin, yellow, putrid odor, acid reaction.		Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> present in small numbers.
LXXIX 8 months.	1 week. Milk.	Slight diarrhoea			Nearly pure of <i>b. coli</i> com., <i>b. lactis aerogenes</i> present in small numbers
LXXX 16 months	2 days. Mixed.	Slightly reduced in flesh.	Frequent, watery, yellow, not offensive.	Bacteria fairly numerous.	Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> in small numbers.
LXXXI 4 months	2 weeks Milk.	Slight diarrhoea.	5 to 6 daily, green, soft, alkaline.		Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> in small numbers.
LXXXII 3 months	10 days. Milk.	Slightly reduced in flesh.	5 to 6 daily, green and lumpy, alkaline.		Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> in small numbers.
LXXXIII 10 months.	2 weeks. Milk.	Well nourished, playful, vomiting.	Not frequent, yellow, fluid, with white lumps, alkaline.	Enormous number of bacteria, long narrow bacilli, short bacilli and cocci.	Chiefly <i>b. coli</i> com., bacillus <u>d</u> in small numbers.
LXXXIV 12 months.	2 weeks. Mixed.	Well nourished and playful.	Not frequent, yellow, acid.		Chiefly <i>b. coli</i> com., <i>b. lactis aerogenes</i> present in large numbers.
LXXXV 6 months	2 weeks. Milk.	Reduced in flesh, vomiting.	Not frequent, green, soft, alkaline.	Few epithelial cells, bacteria numerous.	Chiefly <i>b. coli</i> com., bacillus <u>a</u> in small numbers.

Case Age	Duration of sickness, diet.	Physical condition	Stools		Cultures from contents of rectum.
			Macroscopic	Microscopic	
LXXXVI 4 months	2 weeks Milk.	Well nourished.	Not frequent, soft, yellow, acid.	Chiefly bacteria.	B. coli com., greatly predominates, b. lactis aerogenes in small numbers.
LXXXVII 12 months	2 weeks. Milk.	Emaciated, bronchial râles over whole chest.	5 to 8 daily, whitish yellow, fluid, sickly fecal odor.	Large number of bacilli of different forms, few cocci.	Chiefly b. coli com., few liquefiers.
LXXXVIII 7 months.	... Milk.	Diarrhoea and constipation alternately, emaciated, skin inelastic.	6 to 8 daily, green with white lumps, pasty.	Bacteria numerous.	Chiefly b. coli communis.
LXXXIX 5 months.	3 weeks. Milk.	Fairly well nourished.	4 to 8 daily green and pulpy.	Few leucocytes, many bacilli, few cocci.	Nearly pure of b. coli communis.
XC 9 months.	Few days. Milk.	Considerably reduced in flesh, Temp. 103° F.	Not frequent, yellow, fluid.	Many bacilli, very few cocci.	Chiefly b. coli com. and b. lactis aerogenes.
XCI 6 months.	10 days. Milk.	Fairly well nourished, fretful.	Not frequent, yellow, with white lumps.	Many bacilli, few cocci.	Almost pure of b. coli communis.
XCII 9 months.	5 to 8 weeks. Milk.	Reduced in flesh, restless	4 to 8 daily, yellow, fluid, with lumps.	Many bacilli, few cocci.	Chiefly b. coli com., b. lactis aerogenes in small numbers.

April 25th 1898.

GARCHES Nr. PARIS. (Chief de Service, M. Prévost)

The Bleeding of the Horse.

A small slit is made a little above the jugular vein. Into this a trocar and cannula is placed, the trocar being withdrawn and blood flows freely. By means of an elastic rubber tube the stream of blood is conveyed to a sterilized

GARCHES Nr. PARIS.

(Chief de Service, M. Prévost)

April 25th 1898.

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into the vessel the metal lid is slightly turned. Then the contained blood is protected by two layers of sterilized paper.

When the operation is completed the cannula is withdrawn from the jugular vein and the wound is closed by (a) the valvular condition of the slit in the vein wall and (b) the elasticity of the wall of the vein. No dressing or stitching is used.

The entire apparatus used for the extraction has been

April 25. 1898.

G A R C H E S, N^r. P A R I S. (Chief de Service, M. Prévost)

The Bleeding of the Horses:-

A small short cut is made obliquely over the jugular vein. Into this a trochar and cannula is placed, and the trochar being withdrawn the blood flows freely. By means of an india rubber tube the stream of blood is conveyed to a sterilized jar (of 4 litres). The top of the jar is covered with two paper coverings before it is sterilized. Then it is covered in another loose one. Before use the loose one is removed and replaced by a metal (zinc) lid which has previously been sterilized in paper. This metal lid contains an aperture large enough for the tube which pierces the two paper covers to pass through. When enough blood has passed into the vessel the metal lid is slightly turned. Thus the contained blood is protected by two layers of sterilized paper.

When the operation is concluded the cannula is withdrawn from the jugular vein and the wound is closed by (a) the valvular condition of the slit in the skin and vein and (b) the elasticity of the wall of the vein. No dressing or stitching is used.

The entire apparatus used in the extraction has been

carefully and fully sterilized in the autoclave.

R. A. B. I. W. S. Institute Pasteur, April 21, 1894
The jar containing the blood is now removed to a dark cool cellar where it stands for three days. During this period coagulation is completed; the yellow serum rises to the top and the corpuscles stick to the bottom. The serum averages about 50% of the total blood taken. In the cellar the serum is drawn off by piercing the double cover with an aspirating needle. This is now bottled in quantities of 5 c. c. which are stoppered with india rubber. The whole of which are incubated at 37° C. Those showing any turbidity are rejected. One bottle of each set is tested upon a ^{human} g. pig. In addition to this test, a control has already been taken of the antitoxic capabilities of the horse by drawing off about 500 c.c. and testing it at the laboratory.

element. This test is performed daily with fresh bouillon. In case of deposit of the slightest turbidity in the broth (at 37.0) the one is rejected. Fourteen series of cords are thus suspended on 14 consecutive days. No. 1, 2, and 3 are found to be of equal virulence but from the 2nd to
One stable kept for Dip^{therina} especially constructed - separate water for each, regularly fed, and regularly exercised - food being given in proportion to condition. 68 horses for Dip^{therina} alone, 3 of these have been at work since 1894 aged 14 years and have ~~been~~ 6 years service. Three of them ^{averaged} 900 litres of blood yielded and are in excellent condition,

R A B I E S. Institute Pasteur, April 21, 1898.

Two rabbits die on the eleventh day. These are laid out on a p. m. board and the transverse process are sawn through and the ~~bone~~ ^{bone} absolutely removed piece-meal by bone forceps. The cord is now divided into three bits and each piece is carefully removed and secured by a piece of sterilized silk and thereby suspended in a sterilized jar from the cotton wool plug. Above a layer of half an inch of dry sterilized CaCl_2 . The jars are then removed to the dark chamber where they are placed at a temperature of $20^\circ - 22^\circ \text{C}$, in wooden cases. Here they are left to ~~dehydrate~~ ^{desiccate}. Above each case is a bouillon tube to which has been added a piece of the corresponding end to test for any ~~organismal~~ ^{organismal} element. This test is performed daily with fresh bouillon. In case of deposit of the slightest turbidity in the ~~broth~~ ^{broth} (at 37°C) the end is rejected. Fourteen series of cords are thus suspended on 14 consecutive days. No. 1. 2. and 3 are found to be of equal virulence but from the 3rd to the 14th the virulency proportionately decreases so that on the 15th day it would be non-virulent. In therapeutics the 14th day cord is used first and so on ~~steadily~~ ^{steadily} ~~instead of~~ increasing doses up to a 3rd day cord. The 14th day cord is therefore taken and rubbed up in a little sterile bouillon, which is placed in a conical glass and covered

Rabies (continued.)

with 2 layers of thick *filter* paper. The glass with its covering having been already sterilized by *dry heat*
Some c. c. *of this* Maceration is then inoculated into the flanks or abdominal wall. On the following day the patient returns for an inoculation of the 13th day. The *doseage* depending upon three classes of bites (1) Through the cloth. (2) A bite on the bare skin of the hand. (3) Or a bite on the face or head.

PREPARATION of the CORD. After the operator has removed the cord, he next removes a small quantity of the bulb of the brain itself about the size of a pea. An emulsion of this is then made in sterilized *broth* and is now ready for injection into the rabbit, which is to be the medium for a fresh rabies. Two rabbits are taken daily and each treated as follows :- The rabbit is extended on its ventral surface upon a board and fixed by its four legs. The hair of the top of the head is now removed by curved scissors and an antero-posterior mesial incision is made through the skin, the surface is thoroughly cleansed and irrigated with carbolic acid (1 -40). The sides of the wound are now held apart by small surface gags. Then with a double way Trephine a small disc of bone is removed having a diameter of $\frac{3}{4}$ ~~(5. -)~~ inch. By means of a small elevator this disc is now raised and removed, leaving bare the Dura mater of the brain, with a sterilized hypodermic syringe a

Preparation of the Cord. (continued)

small quantity (= one 2.3. drops) is now injected under the ~~Dura Mater~~. The needle of the syringe being conveniently curved to facilitate this manipulation. Immediately after further irrigation, the wound is closed with a silk stitch and the rabbit returned to its habitat. No anaesthetics whatever are used, but the animal shews practically speaking no signs of pain. The rabbit feeds up till the seventh day and appears well when it begins to refuse its food and becomes dull and on the eleventh day it dies. ~~From~~ From experiments made by M. Viabet it has been shewn that in case of a dog the *saliva* is virulent 3 days before the appearance of the first symptom of madness, and that is also true of the inoculated rabbit.

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Broyer, $\frac{1}{2}$ c.c. de moëlle dans 3 c.c. de bouillon par personne

(Bouillon de Veau -6- sterylisé ou eau sterylisée.)

No. 1.

TRAITEMENT des MORSURES à TRAVERS VÊTEMENTS.

JOUR.	11hr. MATIN.	3 c.c.	MOELLES	de.	14 JOURS.
1. JOUR	" " "	3 "	" "	" "	13 "
2. "	" " "	3 "	" "	" "	12 "
"	" " "	3 "	" "	" "	11 "
3. "	" " "	3 "	" "	" "	10 "
"	" " "	3 "	" "	" "	9 "
4. "	" " "	3 "	" "	" "	8 "
"	" " "	3 "	" "	" "	7 "
5. "	" " "	3 "	" "	" "	6 "
"	" " "	3 "	" "	" "	6 "
6th "	" " "	3 "	" "	" "	5 "
7. "	" " "	3 "	" "	" "	5 "
8. "	" " "	3 "	" "	" "	4 "
9. "	" " "	2 "	" "	" "	3 "
10. "	" " "	3 "	" "	" "	5 "
11. "	" " "	3 "	" "	" "	5 "
12. "	" " "	3 "	" "	" "	4 "
13. "	" " "	3 "	" "	" "	4 "
14. "	" " "	3 "	" "	" "	3 "
15. "	" " "	3 "	" "	" "	3 "

Broyer, $\frac{1}{2}$ c.c. de moëlle dans 3 c.c. de bouillon par personne

(Bouillon de Veau sterylisé ou eau sterylisée.)

No. 2.

TRAITEMENT des MORSURES aux mains ou sur des PARTIES nues.

1.	JOUR.	11hr MATIN	3 c.c.	MOELLE	de	14 JOURS.
1.	"	"	3	"	"	13
2	"	"	3	"	"	12
		"	3	"	"	11
3	"	"	3	"	"	10
		"	3	"	"	9
4	"	"	3	"	"	8
		"	3	"	"	7
5	"	"	3	"	"	6
		"	3	"	"	6
6	"	"	3	"	"	5
7	"	"	3	"	"	5
8	"	"	3	"	"	4
9	"	"	3	"	"	3
10	"	"	3	"	"	5
11	"	"	3	"	"	5
12	"	"	3	"	"	4
13	"	"	3	"	"	4
14	"	"	3	"	"	3
15	"	"	3	"	"	3
16	"	"	3	"	"	5
17	"	"	3	"	"	4
18	"	"	3	"	"	3

(Continued)
No. 3.

TRAITEMENT des MORSURES à la TÊTE
~~TRAITEMENT des MORSURES à la TÊTE.~~

1.	JOUR	11 MATIN	3 c.c.	MOELLE	de	14 JOURS
18	JOUR	11 " MATIN	3 " c. c.	" MOELLE	de	13 JOURS
19	"	3 SOIR	3 "	" "		12 "
20	"	3 " "	3 "	" "		11 "
21	"	11 MATIN	3 "	" "		10 "
		11 "	3	"		9 "
		3 SOIR	3	"		8 "
		3 "	3	"		7 "
3	"	11 MATIN	3	"		6 "
		11 "	3	"		6 "
4	"	11 "	3	"		5 "
5	"	" " " "	3	"		5 "
6	"	" "	3	"		4 "
7	"	" "	3	"		3 "
8	"	" "	3	"		4 "
9	"	" "	3	"		3 "
10	"	" "	3	"		5 "
11	"	" "	3	"		5 "
12	"	" "	3	"		4 "
13	"	" "	3	"		4 "
14	"	" "	3	"		3 "
15	"	" "	3	"		3 "
16	"	" "	3	"		5 "
17	"	" "	3	"		4 "

(Continued)

No. 3

TRAITEMENT des MORSURES a la TÊTE.

18	JOUR	11 MATIN	3. c. c.	MOELLE de	3 JOURS
19	"	" "	3	"	5 "
20	"	" "	3	"	4 "
21	"	" "	3	"	3 "

MOIS

INSTITUT PASTEUR.

Derniere injection (

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N°

DIPHTERIE

Dates	Vaccina- tions.	Quantité de Vaccin. par In- ject ⁿ . Totale	Tempéra- ture.	Observations.
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2				
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